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A Comparison of
Time and Motion Studies

By Stewart M. Lowry

WHEN taken literally, the terms time study and motion study convey very different meanings. Time study, in the strictest interpretation, can mean little more than the measurement, with or without recording, of the duration of an action or sequence of actions, or of the elapsed periods between actions. These actions or periods of inaction may or may not involve the human element, but as applied to industry, the human factor is usually involved. In the strict sense, time study does not comprehend an analysis of methods, although in actual practice the term implies, in addition to the measurement of elapsed time, a detailed scientific study of methods with a view toward determining the "one best way."

On the other hand, motion study implies in its narrow sense no more than the observation and analysis of motions to the end that the most efficient manner of executing them may be determined. Strictly speaking, if there were no discernible motion there could be no motion study. Although there is nothing in the term itself to imply a consideration of the time element, yet a practical motion study no more eliminates the time element than a time study eliminates a scientific analysis and standardization of motions.

The predominating element in F. W. Taylor's earlier researches being time, the term time study was coined to identify these practices. As more and more attention was devoted to analyzing and improving methods in conjunction with the actual time measurements, this phase of time study came to be known as motion study. The operations were sub-divided into the smallest elements that were practical for observation. These elements were scrutinized to determine the "one best way." Unnecessary motions were eliminated, and better and easier ones were substituted where possible. Through it all, however, the time element was never omitted. Determining the one best way was no more important than its measurement, since the ultimate objective was to make possible the production of more units, or the accomplishment of more work, in a given time without working hardship to the workers or a reduction of the quality of the work. To gain the cooperation of the actual producers, wage incentive plans were developed, whereby earnings were increased for increased accomplishments. Time was essential in applying a measure that would make these wage incentive plans workable. For the sake of brevity the term time study is generally used in place of what should more properly be called time and motion study or to be strictly chronological, motion and time study, inasmuch as the motion study is always made before the time study.

While the use of the terms time study and motion study often implies two distinct schools of thought, the author of this article seeks to show that the differences are merely in method and application, that there is no sharp dividing line, but that one is perforce a function of the other

Apart from those who advocate and practice time study, including of course, as an important feature, an analytical motion study, there is a group of modern authorities, chiefly disciples of the late Frank B. Gilbreth, who identify their methods as motion study. As previously explained, this term is fully as misleading when standing alone as is the term time study alone, as motion study implies the exclusion of the time element, which is by no means the case in actual practice. In fact, the degree of accuracy to which time is measured is greater in motion study than in time study.

With these points of similarity, it will be readily understood why the justification for controversy is questioned. The likeness of fundamental purposes and objectives makes both systems easily traceable to the same origin. Divergences of opinions regarding the proper detailed methods for arriving at the desired results is responsible for whatever differences that exist at the present time.

One of the chief points of difference is in the kind of equipment used. Motion study employs accurate and

expensive equipment, including such things as motion picture cameras, small electric lights attached to the worker's fingers and other parts of his body, cross-sectional background screens against which the photographs are made, and an accurate time-piece known as a microchronometer, which is placed in the focal field of the camera.

This sort of equipment is obviously unwieldy for use on the production floor, so it is necessary to conduct most of the studies in a laboratory set apart and especially equipped for the purpose. However, in some cases, involving such operations as those on heavy machines that cannot be moved to the laboratory, the studies are made in the shop after having approximated laboratory conditions by means of screens and the arrangement of special equipment.

Theoretically, each individual motion may be subdivided into standard elemental parts. Mr. Gilbreth defined these elemental parts and named them "therbligs." The object is to determine how each motion may be simplified or shortened by eliminating the unnecessary "therbligs." It will be recognized that great stress is placed upon the minute analysis of elementary motions. The nearly ideal conditions that are created for the studies, and the extremely accurate methods employed in making the studies lends to motion study an element of scientific exactness which is of great value to industry from a research standpoint. It has contributed greatly to the determination and reduction to a minimum of the causes of fatigue.

Consideration of Methods

In motion study, emphasis is placed on studying methods, while the time required is regarded as secondary. Method is undoubtedly of considerable importance, particularly in a processing industry where volume is large in relation to payroll, and where material costs have a high relation to labor costs. In the great majority of businesses, however, there are continual changes in manufacturing methods, and it is questionable whether such a high degree of analysis really pays. The elaborate equipment and laboratory condition necessary for motion study also make it impracticable for the small plants that constitute the majority of industrial enterprises. Photographic motion study records are always dependable, as the relation of motions to time is recorded automatically more accurately than is possible by a human observer, but it may be questioned from a practical viewpoint as to whether the results in all cases justify the means. In short, motion study is a highly developed form of what is called analysis and standardization in time study.

Time study, or the modern development of the original time and motion study, on the other hand, is designed along simpler and more comprehensive lines. It is a practical working system, admittedly of less scientific accuracy than motion study, but one that may be applied in any industry, requiring only simple and inexpensive equipment, and securing quick results under normal operating conditions with a minimum of interference with production and with little effect upon the mental attitude of the worker. The only equipment necessary is a stop-watch, pencil and paper. Time study does not require men of as highly specialized experience as does motion study, although the judgment requirements may be higher. The ease of application without interference with regular factory operations is an advantage in favor of time study. The men who are working daily on a factory floor under average conditions, and not in a laboratory under artificial conditions, will have more confidence in the fairness of tasks, the establishment of which has been done under actual operating conditions.

By special supervision a few selected jobs may be operated as they would be in a motion study laboratory, but it would be difficult to run a whole factory in that way. Assuming that it were possible, the extra supervision necessary to maintain near ideal conditions would probably cost as much as or more than any savings that might be credited to the use of motion study, as compared with the correct application of time study methods.

Selecting the Proper Subject

In taking motion pictures of men at work, more especially if they have flashing lights attached to their hands, the subjects for the studies cannot be selected at random from the shop floor, if it is expected to secure a normal and natural performance of the work. To work naturally the worker must be free from any feeling of self consciousness. The average factory worker cannot face a camera without a distinct feeling of self consciousness. If composure before the camera is the primary requisite, then the number of people who can be studied successfully is very limited, and many of the most highly skilled men on certain classes of work are automatically eliminated. This will often mean then that an inferior operator must perform the work when it is desired to study these jobs.

By inclination and training any worker is better adapted to some kinds of work than to other kinds. A man may have certain qualifications that make him a particularly desirable subject for motion studies, but his ability cannot be the same on each of a large variety of jobs. He will excel in some and be unfitted for others. Another man, who can do well the jobs for which the first operator is unfitted, may be an impossible subject from an observation standpoint. On account of its simplicity time study is not confronted with obstacles of this kind, as there is less tendency to self consciousness on the part of the operator when under observation.

The aim of time study is to subject each operation of a given piece of work to close analysis, in order that every unnecessary operation may be eliminated, and in order to determine the quickest and best method of performing each necessary operation; also to standardize equipment, methods and working conditions; then, and not until then, to determine the number of standard hours in which an average man can do the job. There is little difference between this and the aim of motion study, except that motion study aims to determine and establish as the standard value the absolute minimum of time in which it is possible to do a piece of work. Theoretically, this standard value would never be bettered in practice. Time study uses the performance of the average man as its basis for determining standard time. This fact probably has a more favorable psychological effect upon workers in general, since this value is one which the majority of them can meet, which fact tends to eliminate discouragement and lack of co-operation at the start.

In addition to the differences in equipment and methods used, there is also a difference in the extent of the fields in which the two systems may be applied satisfactorily. Motion study has many times justified its existence, and has proved its superiority over time study

in limited fields. In measuring the effect of fatigue upon performance, time study cannot approach the accurate results that can be secured through the medium of motion study. Where the results justify the expense and delay, motion study is better adapted to carrying on exhaustive researches on the control and synchronization of different muscular actions, or even on the co-ordination of muscular and mental powers, as regards their relation to the performance of detailed elemental motions. Motion study may be used to advantage in a processing industry, or in a business where the methods of performing the work remain standard for a long time after they are established. In particular, it is applicable to repetitive manual operations requiring great dexterity of movement rather than to operations including machining time, and where the actual movements of the worker are few. Jobbing work and short orders are not well adapted to motion study on account of the time required for preparation and determining the results of the study.

Time study, on the other hand, has an unlimited field. The intensiveness of the preliminary analysis and standardization of operations will be determined largely by the importance of the job itself, and by the time available to the time study man for arriving at his results. Short jobs that are not likely to be repeated soon will not justify the close analysis that would be devoted to studies that will be used to establish values on a large line of active work. Time study lends itself readily to the accumulation of related data that may be used in constructing formulas for establishing values on any job in a large line of work without studying each individual job. In times of urgency, a time study may be made and satisfactory results secured with no preliminary preparation. It is, moreover, not difficult to explain time study principles even to the less intelligent operators in order to secure their co-operation.

Separate Fields

By way of summary it will be seen that motion study and time study each has its own field. While the field of motion study is greatly limited from a practical standpoint, its value in some applications cannot be disputed. Motion study, a laboratory science, might be likened to the highly sensitive scales in a physical laboratory. Such scales are essential to scientific experiments and in doing work requiring the ultimate in accuracy, but would be impracticable in the corner grocery where measurement to the small fraction of an ounce is not necessary. Time study may be likened to the grocer's scales in that it is designed to secure quick and economical results with a minimum of equipment and preliminary preparations.

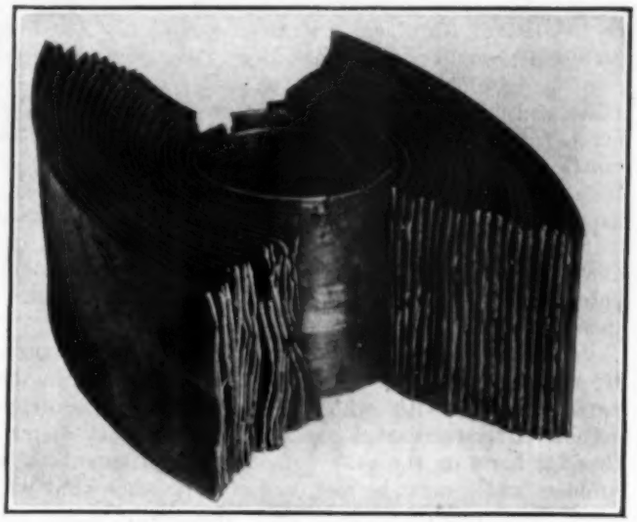
The advocate of motion study must show that it will apply to the field in which he is attempting to introduce it, and that the elaborate features of equipment and methods are justified by the superiority of results that can be secured. The time study man, to retain the favored position which his system now occupies, must show that his field is much broader, and includes considerable area that motion study cannot enter, and also that he can accomplish satisfactory, if somewhat less accurate, results even in the limited field that is open to motion study. He must show that his is a practical system designed to accomplish the most for the cost, and that any greater accuracy that may be secured by the use of motion study does not justify the cost and trouble.

A Peculiar Break

By Henry C. Hitt

ONE of the coil springs on my phonograph recently failed, and on opening it up I discovered the very remarkable condition shown in the illustration.

The spring was in forty-six different pieces, forty-two of which show in the photograph. Two or three coils on the outside were in large pieces which were a foot or more in diameter, and I discarded them. I do not know when the break occurred—simply discovered the phonograph would not wind. This spring had been in use over ten years, though not very much of late. It was rather dry, though certainly not excessively so. The graphite showed plainly and the broken pieces were very slippery to handle.



Broken phonograph spring

Though the whole fracture is very hard to explain, the illustration shows the remarkable way the two breaks ran through adjacent coils as though the spring as a whole was solid metal. The break in each coil takes the shape of those on either side, and nearly every irregularity runs through a number of coils.

A Serial Number with a Meaning

By Arthur A. Merry

THE prime reason for putting serial numbers on machines is to identify them when repair parts are ordered. In order to make these numbers more useful I would propose the following method.

For example, take the number 32750. The first numeral, three, tells us that the machine was made in March. The next two numbers tell us that it was in the year nineteen twenty-seven. The last number, fifty, tells us that it was the fiftieth machine finished that month.

This method of numbering has no chance for duplication and really tells quite some story without having to consult records.

A person dealing in second hand tools would find this method very helpful because it would not be necessary to write the manufacturer to ascertain the age of the machine.

What Makes a Patent Valuable

By F. Transom

Patent Lawyer, Ex-Examiner U. S. Patent Office

THE number of United States patents for inventions granted yearly at present approximates 50,000. Some of these patents will confer wealth and independence on the inventors successful in getting them; many of them, however, will turn out to be nothing but tribulations to their grantees. For all that, and taking the output of patents as a whole, it appears reasonable to suppose that most inventors find their labors profitable, or the list of grantees, instead of constantly swelling each year, would come to an end. This view is amply confirmed in looking back at the past rewards given to successful inventors, and is evidenced by many great plants and industrial organizations which got their starts almost wholly because of 17-year monopolies of their products granted in patents. Some of these great manufacturers now profess to attach little importance to their early patents, ascribing their success to one or another good business quality, overlooking the fact that patent monopolies gave them the business to practice these good qualities on.

Value in a patent comes primarily from the inventor. He need not be learned, or even highly educated in the particular art with which his improvement is concerned, but a successful inventor has the knack of putting his hand on the really essential requirements of a problem which must be met, and of indicating what will meet these requirements. Very frequently, after the solution of a problem has thus been arrived at, the learned and well educated man can explain the invention even better than the inventor who originated it.

Assuming that an inventor has made a valuable discovery, his next concern is to obtain a patent which will protect him adequately in the use of his invention. One of the hardships of inventing is that the value of the patent secured is not always commensurate with the value of the invention.

Protected by Courts

One reason an inventor has for expecting a patent to turn out valuable is that the grant of patents for inventions since the very beginning of the United States Government has been under the control of the United States Supreme Court. The importance of inventions to the welfare of the country was so well understood that the Constitution itself made provision for the issue of patents, and even today the United States Supreme Court will pause in its other work to pass on the validity of a rule of practice of the United States Patent Office.

Some of the most profitable patents granted have been repeatedly rejected in the patent office before allowance. The question of what constitutes an invention in a particular improvement is not always easy to see, even though it has been satisfactorily answered in a number of other cases. Invention is something the courts do not commit themselves to giving any set definition to.

A fundamental requirement with which all patent seekers must comply is to furnish a full disclosure of the invention to the commissioner of patents. When the patent term expires this disclosure becomes public property, hence the patent office generally sees to it that the disclosure is satisfactory, but while patent office criticisms are often very helpful in clearing up any obscurities of disclosure, an inventor should err on the side of clearness, if at all, because an insufficient disclosure means an invalid patent in the courts.

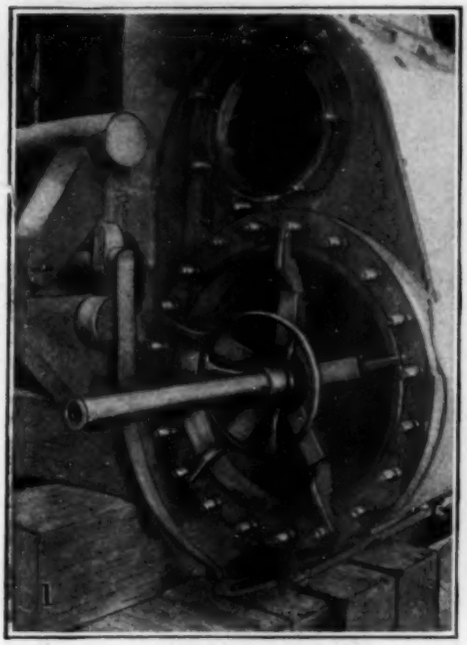
Just as progress cannot be made without the inventor to strike out on the right path, so must the inventor be guided by proper counsel as to what and how much of an advance has been made. The attorney must be able to see beyond the often crude evidences of improvement that the real invention has not yet been uncovered. During this development period an inventor should emulate the classical disclosure given by Professor Röntgen of the discovery of the X-ray, which he did not patent, and the very thorough information the Wright brothers were able to advance about airplanes.

When an invention is completed, to the extent that a demonstration of operativeness may be given, if any question is raised in regard thereto, the inventor's work is finished. It now becomes the duty of the attorney to faithfully represent in drawings and well chosen descriptive matter what is regarded as novel and useful. This must be correctly presented furthermore from the standpoint of being a broad invention, or a limited improvement, and with the knowledge that only one invention is patentable for each application.

Must Back up Claims

Supposing the disclosure of the invention to be all that it should be, the applicant for a patent now faces the requirement that he claim all that is novel in his invention. Upon successful compliance with this requirement depends his monetary success as an inventor. Unless an application happens to present subject matter interfering with that of applications made by other inventors, the patent office will give no assistance in the determination of what is to be claimed, beyond seeing that whatever claims are made are formal claims. An applicant may give an excellent disclosure of a valuable invention and present formal claims, but so limited as to be practically worthless, and the patent office will simply pass the case to issue. The only safety in the matter of getting suitable claims for the average inventor is to be able to present claims, both broad and limited, which fully cover what he has done. Having properly presented his claims, an inventor must stand up for his convictions. Patent reports are full of instances where such insistence has won out in the end.

There never was a time when the outlook for successful inventing was so bright as at present. Only a couple of years ago everything was uncertain as to whether two wheel or four wheel brakes should be used on automobiles. That broad question has apparently been decided in favor of the four wheel, and the art now awaits an authoritative dictum from some inventor to tell us whether to use mechanical, hydraulic, or electrical control for these brakes. When the right decision is made it will inevitably sweep the other two systems away, just as the cross field regulator on automobile generators cured all doubts as to how to avoid blown fuses and burnt out lamps. The airplane must be brought under much safer descent control. An automobile headlight is needed which can be both looked at and seen with. A flivver household refrigerator is needed that will duplicate its well known prototype in efficiency, and perhaps also freeze the little blocks into real ice. So the list might be extended, and when these things have been brought about, the greatest surprise of all will be the personalities of the inventors who blazed the trails. May they get their rewards, even as they scatter their blessings.



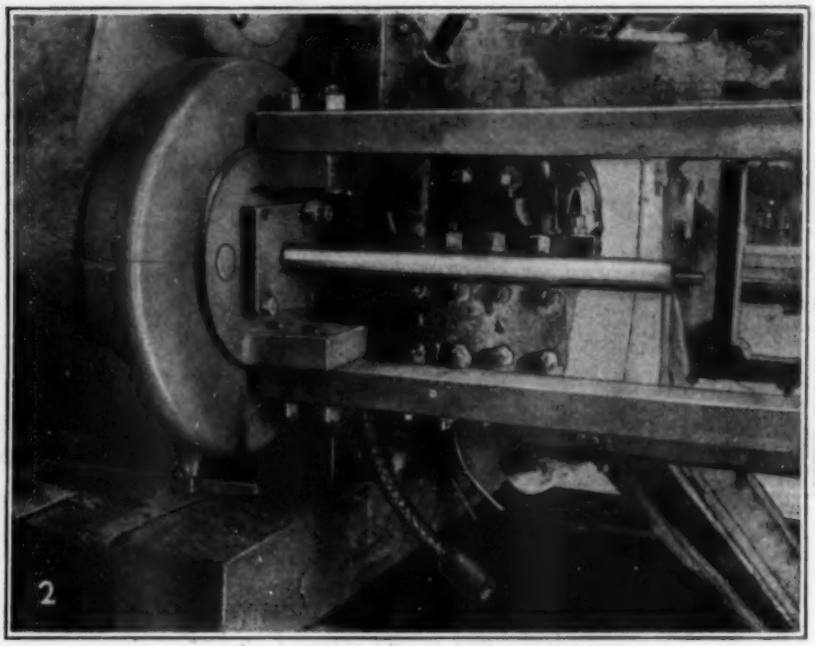


Fig. 1—Tool used in aligning cylinder and crosshead—front view. Fig. 2—Rear view

Short-Cut and Accuracy Devices in a Railroad Shop

By L. C. MORROW
Managing Editor, American Machinist

ONE of the policies of the repair shops of the Oregon and Washington R.R., Albina, Ore., division of the Union Pacific System, is to provide mechanical devices for the sake of securing accuracy as well as saving time. It is to examples of such devices that this article is chiefly devoted. One of these short-cut aids is used to secure alignment of cylinder and crosshead, a job wherein it is necessary to adjust the crosshead guides until they are parallel with the axis of the cylinder. The aligning tool illustrated in Figs. 1 and 2 is used. The spider, applied to the front end of the cylinder, is self-centering, the five jaws being pulled up on a taper collar by right-hand rotation of the handwheel. At the rear end, the aligning bar is located in a bored plate, set central with the bore of the cylinder. In making the alignment, the crosshead is placed between the guides, and the guides are adjusted until the bar will enter and be central with the piston-rod hole of the crosshead in all positions of its travel. The aligning bar has a sliding fit in its two supports and can be moved along readily by hand. In the toolroom, the lapping plate shown in Fig. 3 has proved a great convenience. An 18-in. cast-iron disk, surfaced with lead, is mounted on a vertical shaft driven by worm and helical gear from a 3-step cone shaft connected by belt to a countershaft on the ceiling of the story below. The lever in the foreground is the handle of the belt shifter. For purposes of illustration, the front part of the sheet-metal guard was removed. Cellar screens are shaped to fit the journals on the block illustrated in Fig. 4. It is a cast-iron block with a lug that rests on the rear vise jaw. A lead mallet is used. The scribing tool shown in Fig. 5 is used to mark the lines to which the crosshead shoes must be machined to be central with the crosshead. The mandrel, which extends through the crosshead, is drilled to receive the scriber at the rear end also, and lines are scribed on both ends of the shoes. The combination pedestal and binder gage, Fig. 6, has four jaws, each with two functioning ends. In order to use the gage in machining the binder to fit the pedestal,

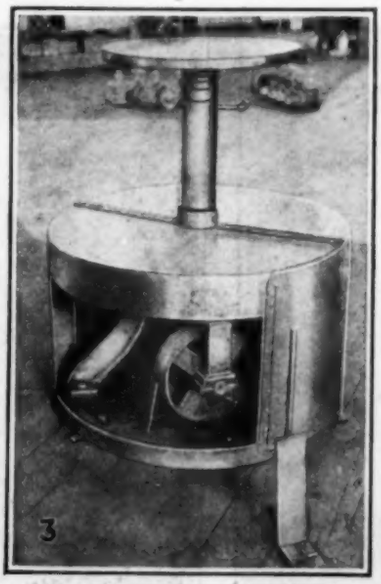
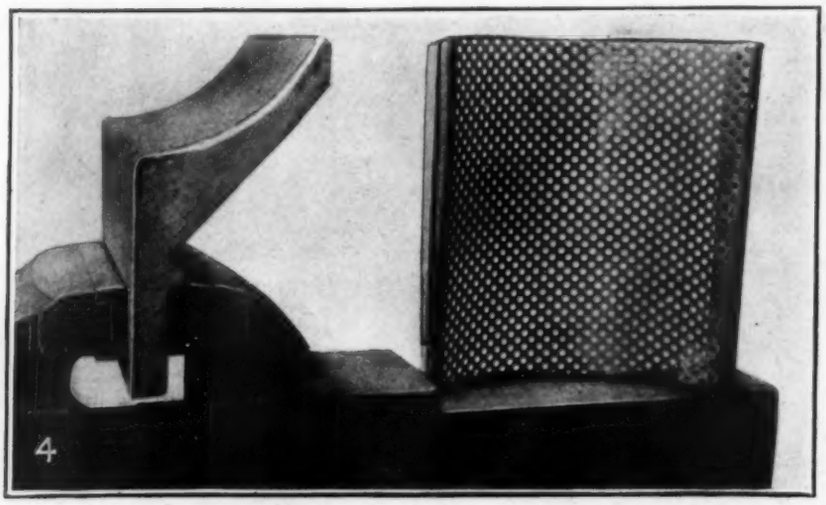


Fig. 3—Lapping machine



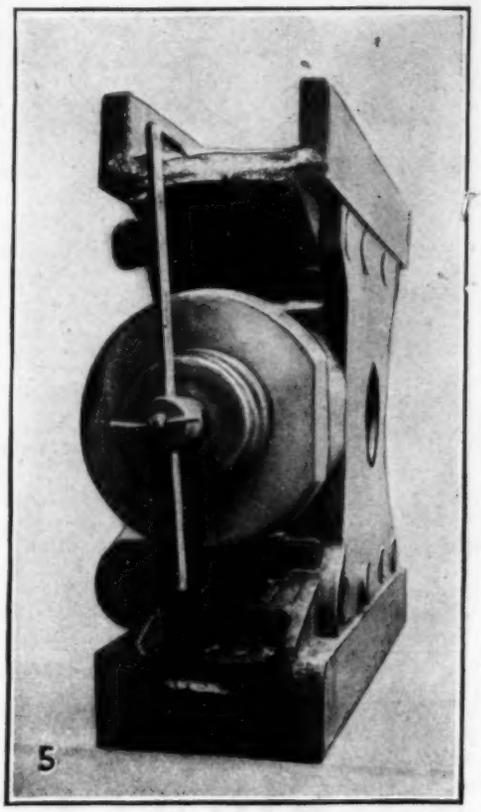
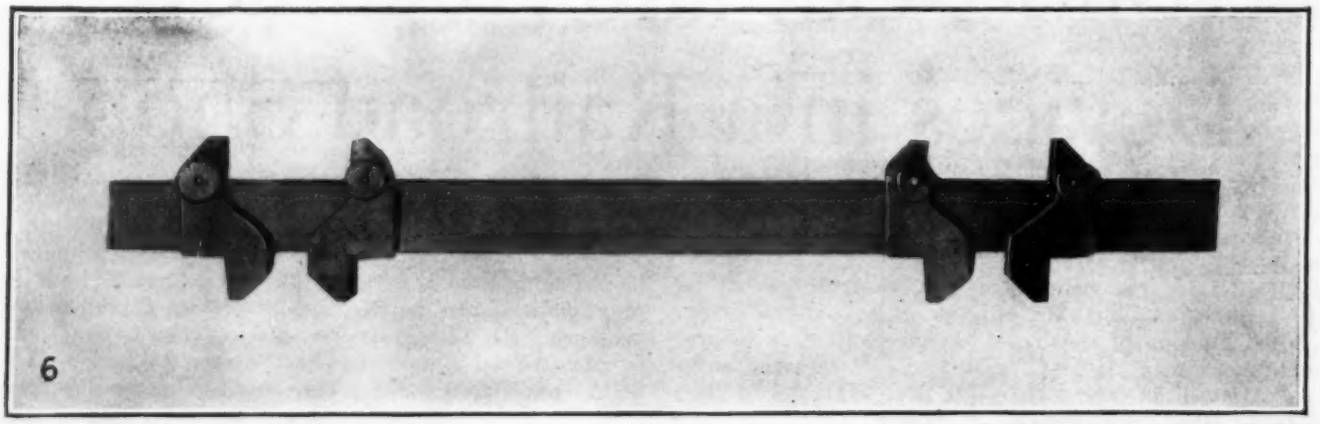
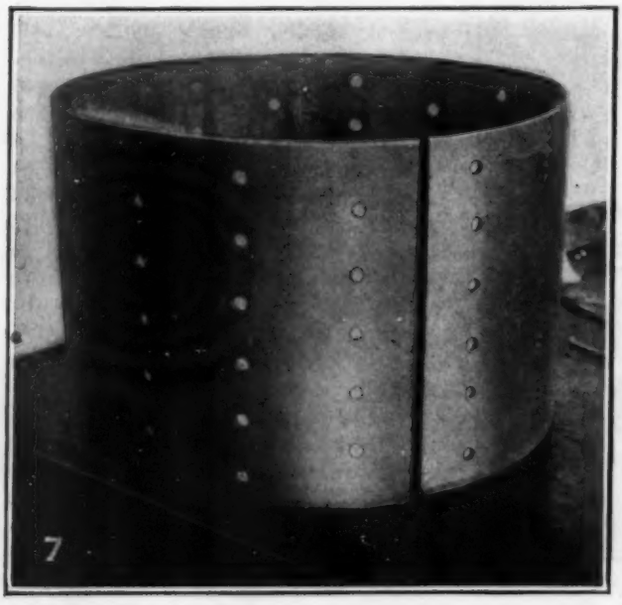
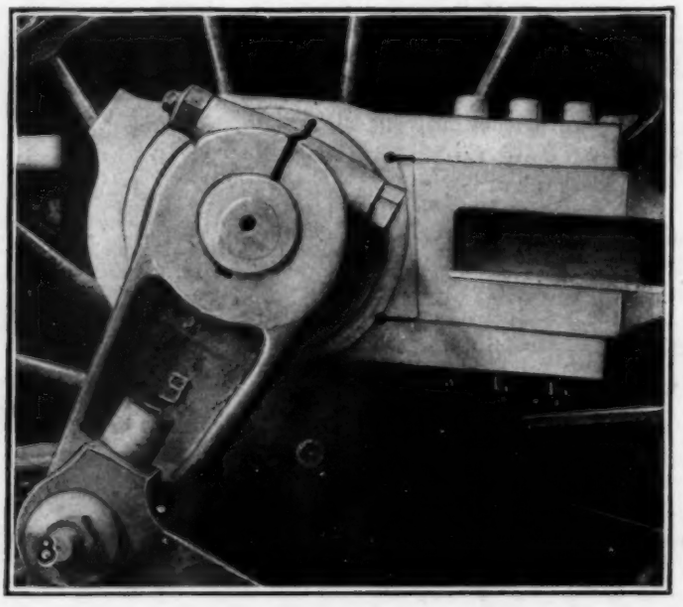
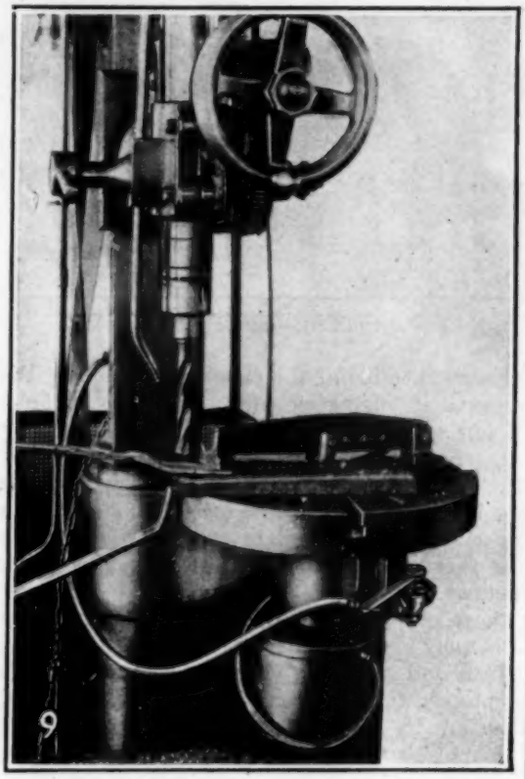


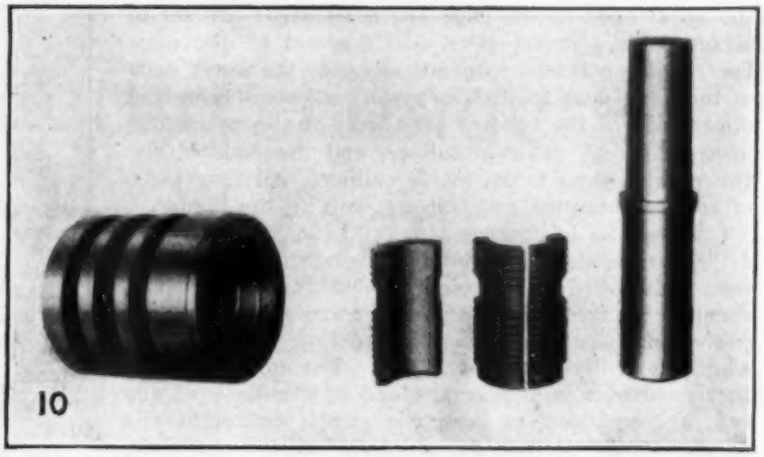
Fig. 4—Block on which cellar screens are shaped to fit journals. Fig. 5—Scriber for machining lines on cross-head shoes. Fig. 6—Pedestal and binder gage. Fig. 7—Templet used in drilling grease holes in bushings for solid-end main rods. Fig. 8—Solid-end main rod adapter

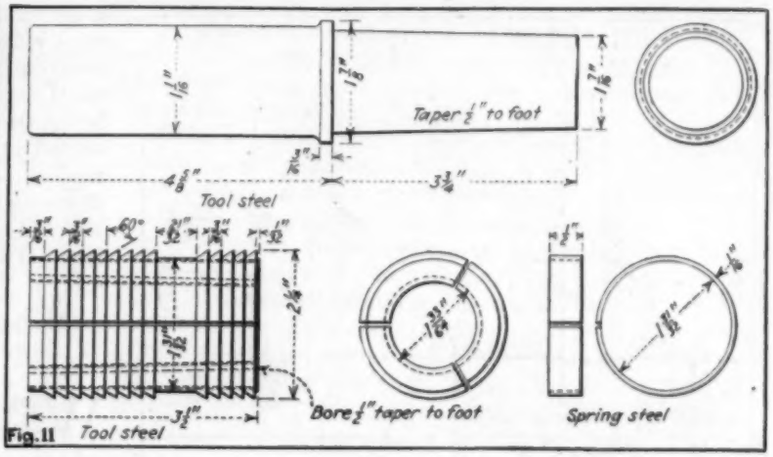












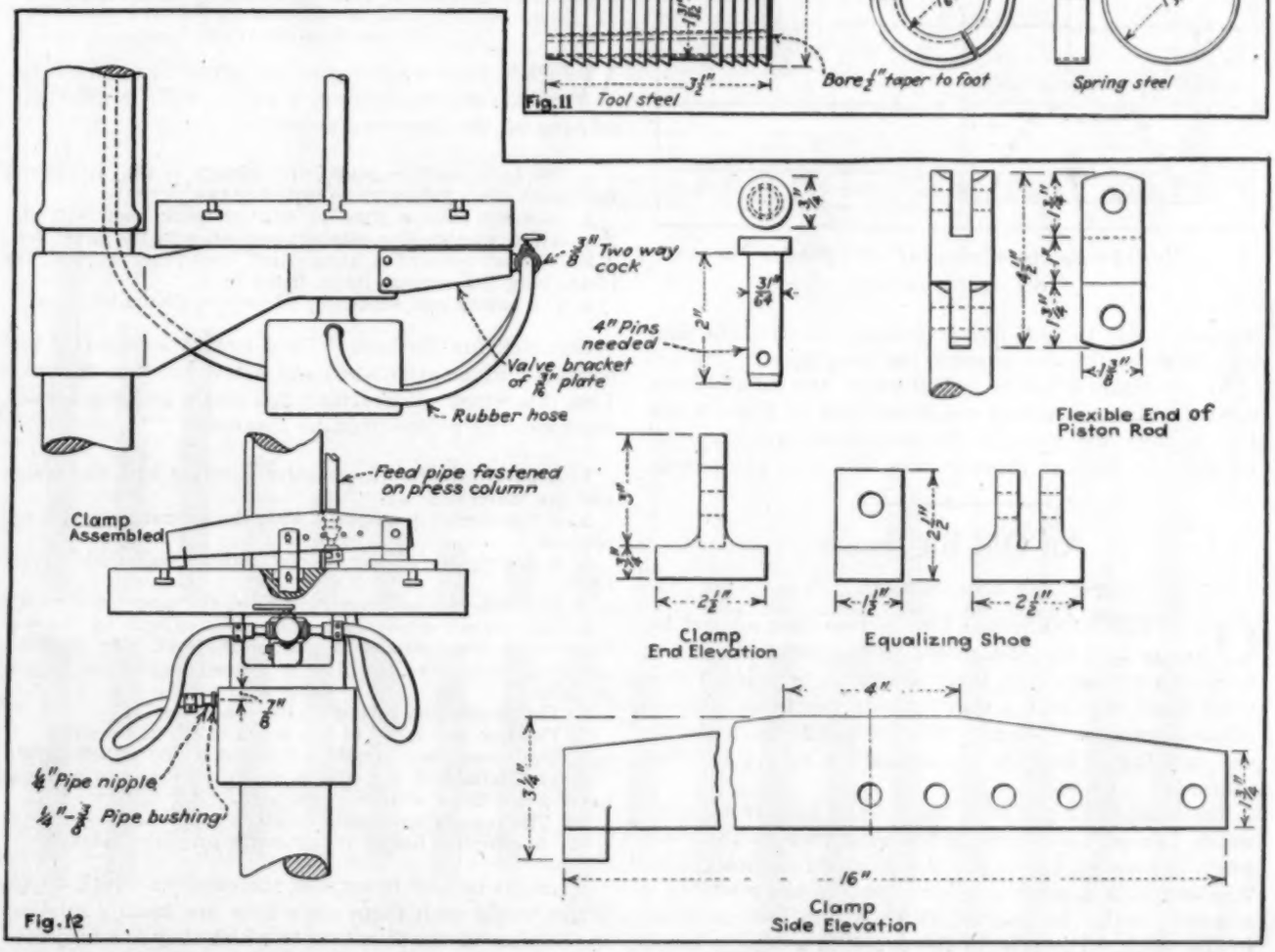


Fig. 9—Air clamp on drill press. Fig. 10—Air-pump valve-bushing extractor. Fig. 11—Details of air-pump valve-bushing extractor. Fig. 12—Piping diagram and details of air clamp for drill press

the upper ends of the gage (as illustrated) are set to straddle the pedestal jaws, and clamped on the gage bar. This operation automatically sets the lower ends of the gage jaws so that they will indicate the desired dimensions of the binder. The ends of the two inside jaws act as an external caliper, and the ends of the two outside jaws as an inside caliper. All four ends, of course, enter the pedestal-jaw slots in the binder.

Grease holes in bushings for solid-end main rods are drilled to the sheet-steel templet shown in Fig. 7. The templet is pulled tight around the bushing by two small clamps. Many old rods, of the box and strap type, are converted to rods of the solid-end type by using the adapter end illustrated by Fig. 8. The holes and slots in the adapter end, near the end of the body of the rod, are provided to keep the strap portion of the adapter cool. It was found that, without the slots,

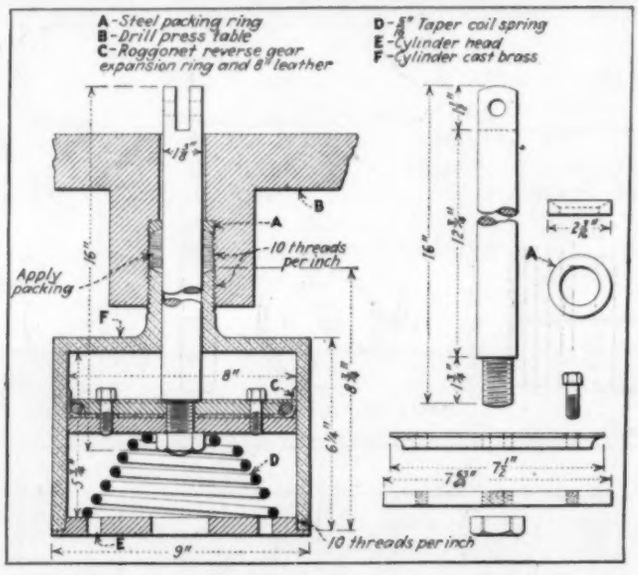


Fig. 13—Sectional view of air cylinder for drill press clamp

expansion due to heat had a tendency to strip the first bolt, that is, the one nearest the bearing.

An air clamp fitted to a drill press, and an air-pump valve-bushing extractor, are illustrated in Figs. 9 and 10. Details are given in the line drawings, Figs. 11, 12, and 13. Both of these devices save time and money.

An Old Bit-Brace

BY GEO. WILSON

ON SEVERAL occasions I have come upon ancient bit braces like the one shown in the illustration, and from the similarity in their design it is evident that there must have been a shop turning them out in quantities years ago. The man who presented me with this one said it had been in his family for over a hundred years.

The brace is made of a hard wood similar to apple wood. To give strength to the bends where the wood grain is crossed, brass plates are inlaid on both sides. The chuck is a brass casting fitted to the wood in a manner similar to that in which a gun lock is inlaid in the stock. The hole in the chuck is a square taper. A notch on the square of the bit shank is caught by a spring latch in the chuck. A button on the latch

An old bit-brace

extends through the side of the chuck for releasing the spring pressure in changing bits. The breast knob turns on a pin set in the wood.

The brace shown had been broken and repaired by winding the grip with copper wire and covering the wire with solder. A break in the lower bend had been repaired by riveting a steel plate over it. This is the third one of these ancient tools I have seen, the others being in perfect condition. A nicer job than is represented in these old tools, I have not seen on anything modern. If any of the readers of the *American Machinist* can tell anything about these old braces I would be pleased to hear from them and to learn just how old they are.

What Should the Catalog Contain?

BY JOHN S. SWAUGER

WHEN I use a catalog to the advantage of both the manufacturer issuing it and myself, it must satisfy me on the following points:

1. The book must be bound well enough so that it will not fall apart when subjected to ordinary use.
2. It must have a date or edition mark that will distinguish it from similar catalogs published by the same firm.
3. It must present a simple but fool-proof system for identifying the various items listed in it.
4. The names and addresses of dealers should be listed.

So much for the book. Then I must secure real and complete information upon any particular item in which I am interested. Concerning machinery and accessories, the following points must be covered:

1. A description of the machine covering both the design and the material.
2. A functional description with the operating cycles explained.
3. A description of any special features and their advantages.
4. The size and capacity ratings of the machine.
5. The overall dimensions and a photograph of the machine with some means of gaging the size. An operator standing beside the machine is a good means for gaging the size.
6. The production rating of the machine.
7. The size and speed of the motor if one is required.
8. The horsepower required if the machine is belt driven.
9. The details of air, steam or water pressure and volumes when these elements are used.
10. The foundation requirements.
11. A complete list of repair parts properly indexed.

It might be well if some of the catalogs which quoted prices would omit them since they are usually misleading because of the discounts to which they are subjected. I prefer to get the prices, terms, and delivery dates by direct inquiry.

Bolt Manufacture Hindered by Old Equipment

Average of 64 per cent of 10-year-old equipment indicates lack of development

THE fact that there are actually more machines than men in the bolt, nut, rivet and washer division of the metal-working field shows the dependence which this industry puts on mechanical manufacture. And yet of the approximate 17,000 total metal-working machines, nearly 11,000 have seen ten years, or more, of service.

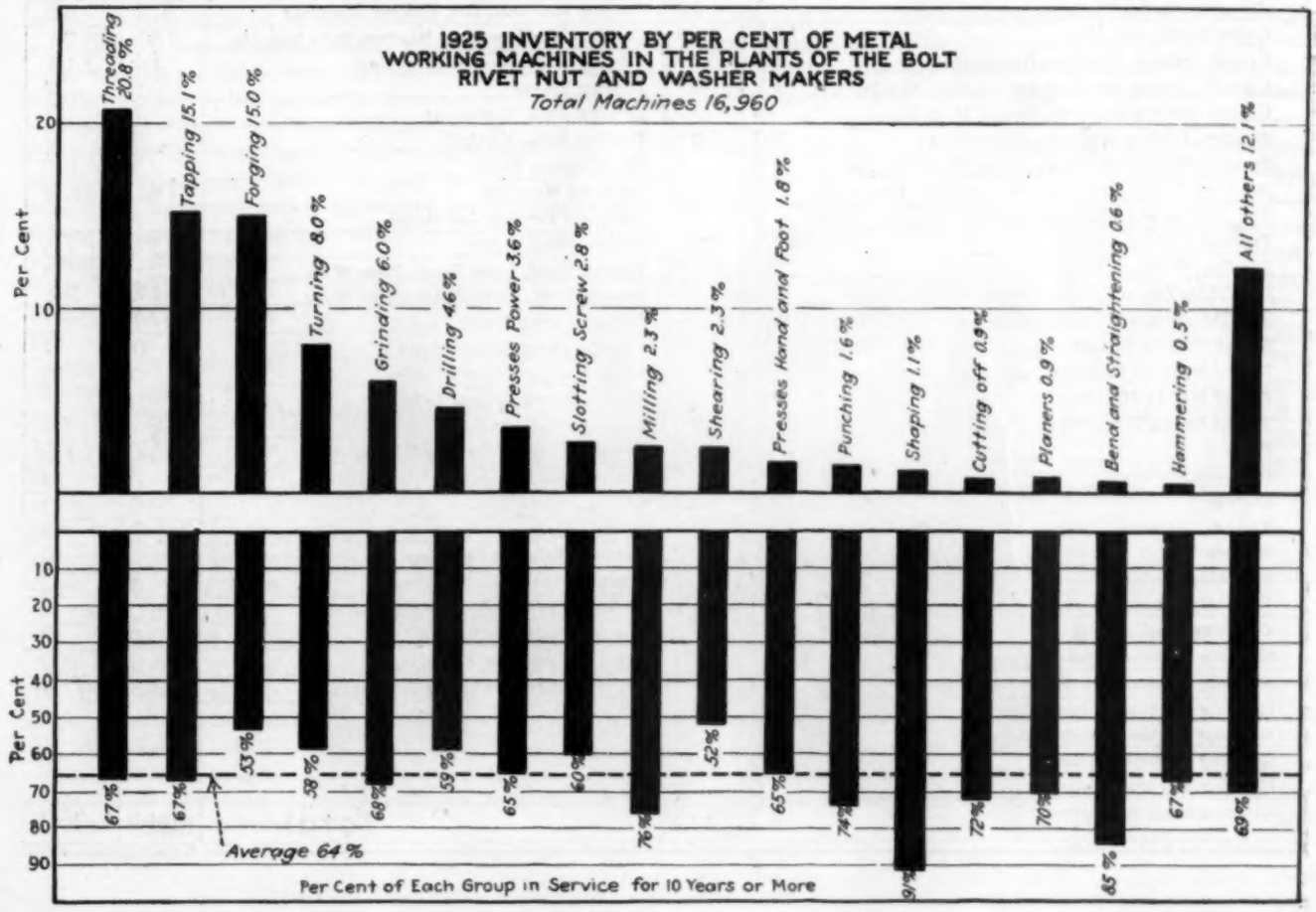
This is a statement of existing averages and does not hold for all types of equipment. In fact a little study of the detail figures in the tabulation on the following page indicates the industry to have taken advantage of existing opportunities for improvement. Thread rolling is an example of the point. The industry purchased 640 thread rolling machines during the past ten years in addition to the 240 already in service.

It would appear that development in machine design to improve existing methods is the thing needed and one that would profit builders of the equipment involved.

As in preceding studies, based on a questionnaire sent out by the *American Machinist*, the chart below shows the division of equipment by operations in per cent of the total and by age average in each group. The questionnaire is reproduced on the following page and shows the tabulation in detail.

Machinery that might be considered as auxiliary in this industry increases the per cent of old equipment. This group includes milling machines, shapers and grinders. The tapping and threading machinery, forming the largest single groups of equipment, are close to the average while the forging and turning equipment is comparatively modern.

The largest single class of machinery in the industry is that of bolt threading and cutting machines. Of the 2,432 machines of this type, 2,095 were bought by the industry prior to 1915. Of the remaining 976 threading machines, only 262 are more than ten years old.



METAL WORKING MACHINES IN THE BOLT NUT RIVET AND WASHER MANUFACTURING PLANTS

Kind of Machine Tool	A Number Built Before 1915	B Total Number in Plants 1925	Kind of Machine Tool	A Number Built Before 1915	B Total Number in Plants 1925
Engine Lathes	348	516	Grinding Machines, Floor, No Feed Attachments	225	283
Hand Turret Lathes	15	22	Grinding Machines, Bench, No Feed Attachments	189	225
Power Turret Lathes	44	58	Grinding Machines, Disk	0	44
Semi-Automatic Lathes	15	15	Grinding Machines, Belt	44	94
Hand Screw Machines	44	44	Grinding Machines, Centerless	0	0
Automatic Screw Machines, Single Spindle	44	218	Polishing and Buffing Machines, Wheel	7	7
Automatic Screw Machines, Multiple Spindle	7	167	Polishing and Buffing Machines, Belt	0	0
Chucking Lathes	44	58	Polishing and Buffing Machines, Semi-Automatic	0	0
Multiple Spindle Chucking Machines, Rotary Work	0	0	Lapping Machines	0	0
Multiple Spindle Chucking Machines, Rotary Tools	0	0	Honing Machines	0	0
Speed Lathes	116	116	Cutting-Off Machines, Parting Tool Type	0	0
Bench Lathes	0	0	Cutting-Off Machines, Power Hack Saw Type	80	116
Tool Room Lathes	116	145	Cutting-Off Machines, Rotary Cold Saw Type	29	29
Wheel Lathes	0	0	Cutting-Off Machines, Band Saw Type	0	7
Axle Lathes	0	0	Cutting-Off Machines, Friction or Hot Saw	0	0
Forge Lathes	0	0	Shears, Knife	181	290
Hand Milling Machines	58	73	Shears, Rotary	22	94
Bench Milling Machines	0	0	Shears, Slitting	0	7
Plain (Knee and Column Type) Milling Machines	167	211	Nibbling Machines	0	0
Universal (Knee and Column Type) Mill. Mach.	51	65	Hammers, Steam	7	7
Vertical (Knee and Column Type) Mill. Mach.	7	15	Hammers, Pneumatic (not portable)	0	22
Lincoln Type Manufacturing Milling Machines	0	0	Hammers, Drop	29	36
Semi-Automatic Type Milling Machines	0	7	Hammers, Helve	15	15
Continuous Mill. Mach. Rotary or Drum Type	15	22	Hammers, Spring	7	7
Planer Type Milling Machines	0	0	Riveting Machines, Pneumatic	0	0
Gear Cutting Machines, Rotary or Milling Type	15	15	Riveting Machines, Hydraulic	0	0
Gear Cutting Machines, Hobbing Type	0	0	Riveting Machines, Steam	0	0
Gear Cutting Machines, Planing or Shaping Type	0	0	Riveting Machines, Power	7	15
Vertical Boring Mills	0	0	Forging Machines, Hot, Bulldozers	0	7
Horizontal Boring Machines	7	29	Forging Machines, Hot, Forging Machines	522	785
Radial Drilling Machines	138	160	Forging Machines, Cold Headers, Bolt, Nut, etc.	785	1451
Upright Drilling Machines, One Spindle	218	327	Forging Machines, Cold, Swaging	44	312
Upright Drilling Machines, Two or More Spindles	22	65	Bending Brakes	0	0
Upright Drilling Machines, Two or More Heads	0	15	Bending Rolls, Horizontal	7	7
Sensitive Drilling Machines, One Spindle	80	203	Bending Rolls, Vertical	0	0
Sensitive Drilling Machines, Two or More Spindles	0	0	Straightening Rolls	73	87
Sensitive Drilling Machines, Two or More Heads	0	0	Punching Machines	196	269
Two-, Three- and Four-way Drilling Machines	0	0	Combined Punches and Shears	7	7
Tapping Machines, Single	1423	1880	Presses, Hand, Arbor	51	73
Tapping Machines, Multiple	290	683	Presses, Hand, Light Punch Press Work	131	218
Pipe Threading and Cutting Machines	15	15	Presses, Foot, Light Punch Press Work	22	22
Bolt Threading and Cutting Machines	2095	2432	Presses, Power, Crank Type	174	247
Thread Chasing Machines	0	102	Presses, Power, Toggle Type	0	0
Thread Hobbing Machines	0	7	Presses, Power, Double-Acting Type	0	0
Thread Milling Machines	22	87	Presses, Power, Dieing Type	0	0
Thread Rolling Machines	240	880	Presses, Power Automatic	65	80
Planers	102	138	Presses, Power, Trimming Presses	152	276
Open-side Planers	0	7	Presses, Power, Forcing, Arbor, Wheel	0	0
Shapers	159	167	Presses, Power, Baling	0	0
Vertical Shapers	7	15	Presses, Hydraulic, Bending, Forming, Drawing	0	7
Slotters	283	472	Presses, Hydraulic, Forging	0	0
Broaching Machines	0	7	Presses, Hydraulic, Flanging	0	0
Keyseating Machines	0	15	Presses, Hydraulic, Forcing, Wheel, etc.	0	0
Centering Machines	7	29	Presses, Hydraulic, Baling	0	0
Grinding Machines, Plain Cylindrical	87	94	Presses, Hydraulic, Extruding	0	7
Grinding Machines, Universal Cylindrical	29	36	All other machines and miscellaneous	1365	1921
Grinding Machines, Surface, Reciprocating	65	116			
Grinding Machines, Surface Rotating	15	15			
Grinding Machines, Internal	0	0			
Grinding Machines, Cylinder	0	0			
Grinding Machines, Cutter	43	116	Total	10,889	16,960

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Cylinder and Crankcase Operations

on Indian Motorcycles

How the aluminum crankcases are machined—Heat-treating the engine castings to season them—Methods of transporting work—Inspecting the finished crankcases

AMONG the several types of machines built by the Indian Motorcycle Co., of Springfield, Mass., is one that has a twin-cylinder motor of 5 hp. in which both pistons act upon the same crankpin. The cylinders are of cast iron, ribbed to radiate the heat generated by the burning gases, and have removable heads. They are bolted directly to a crankcase which constitutes the base of the motor, and by which the power unit is secured to the frame of the cycle.

In Fig. 1 may be seen one of these motors mounted upon the test block. Each motor when set up on the testing stand is connected by a chain to a large centrifugal fan that acts as a dynamometer, and is run for several hours under definitely controlled conditions of load, speed, etc., before it goes to the racks from which the units are taken as needed by the assemblers. To carry away the heat generated by the running motor a blast of air from an electrically driven fan, the speed of which is controllable to correspond with the presumptive speed of the cycle, is directed upon the cylinders. The crankcase is made of an aluminum alloy, and is in two parts, divided circumferentially and joined by a carefully fitted circular mortise, or rabbet. Cast integrally with the right half of the case is the housing for the gear train that governs the timing, drives the magneto, and also drives the generator which supplies current for the lighting equipment of the cycle.

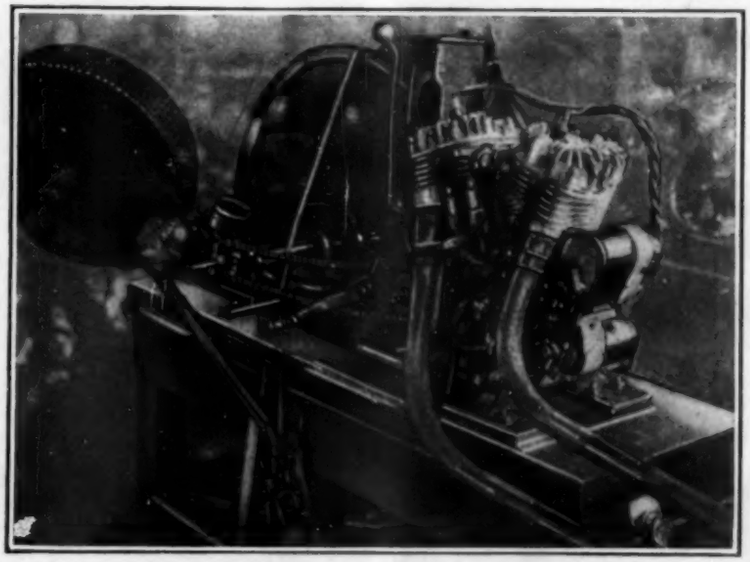

Fig. 1—A motor on the testing stand

The aluminum crankcases are machined upon the inside by Potter & Johnston machines, one of which, tooled to handle its respective half of the case, is used for each part. The machining includes boring, reaming and facing the hub of the central boss in which the crankshaft of the motor takes its bearing, boring the inside of the chamber and facing it where necessary, and making the circular rabbet for the joint, which is a recess on one-half of the case and a projecting shoulder on the other. The lugs for the holding bolts, lying outside the circular part of the case, are also faced at this setting.

These machines are automatic except for unloading and reloading, and complete the work upon each part in about 3½ min., floor to floor time. The diameter at the circular joint is about 9 in., and the machines run at a speed of 280 r.p.m., giving a cutting speed of approximately 650 ft. per min. at this point and a correspondingly faster speed upon the outlying lugs where the cut is intermittent. A mixture of one part cutting oil to nine parts of kerosene is used upon the tools. A pair of the machines set up for the job is shown in Figs. 2 and 3. The depth of the case from the joint to the face of the central boss is important, as are also the diameter of the shoulder and recess of

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the circular mortise, a minus variation of but 0.001 in. being allowed upon the latter dimension. Amplifying gages, examples of which may be seen on the tool board of the machine in Fig. 3, have been developed in this shop to gage the sizes. Their construction is such that a movement of the measuring spindle is greatly multiplied by a pointer that moves over a graduated scale.

From the Potter & Johnston machines the parts of the case go to a multiple-spindle drilling machine, Fig. 4, where the holes for the bolts that are to join the halves are drilled through the lugs. A reversible jig is provided to locate the holes, and the spindles are adjustable to bring the drills into line with the drill bushings, so that when the machine is set up all of the holes are drilled at once. Two of these holes in each part are carefully reamed and become the locating points in subsequent operations.

One of two rows of sensitive drilling machines where many of the remaining operations of drilling, tapping, counterboring and stud-setting are performed is shown in Fig. 5. Both swinging leaf and reversible jigs are used, the parts being located in each by the two reamed holes before mentioned. Further operations of spot-facing and contour milling are performed while the work is mounted upon Pratt & Whitney profiling machines.

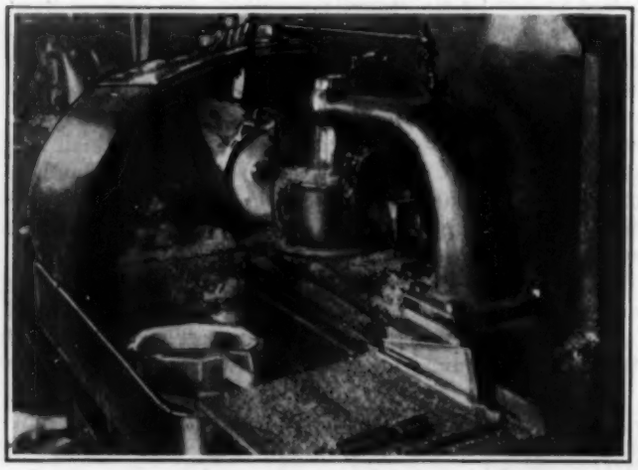

Fig. 2—Machining right half of the base

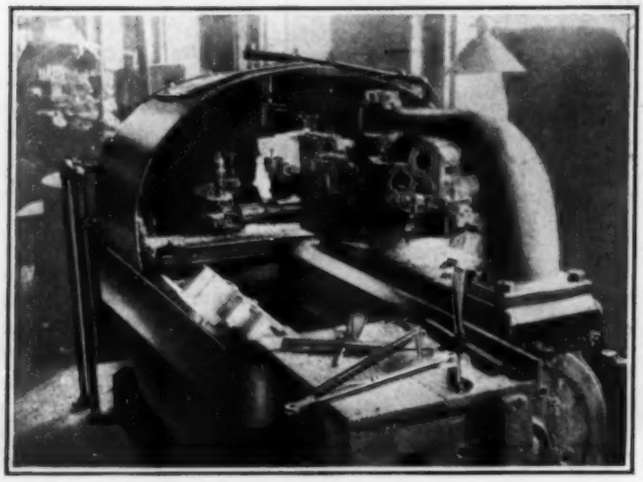

Fig. 3—Opposite half of base, showing gages

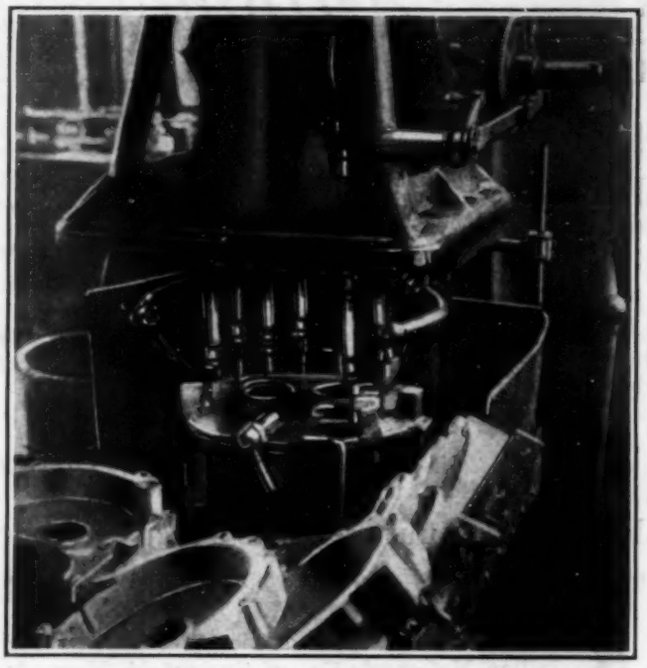

Fig. 4—Drilling for the holding bolts

To transport the cases from one job to another, or to the assembling room when finished, wheeled cabinets like that shown in Fig. 6 are provided. After the drilling and profiling operations are finished the halves are joined by two bolts, the bodies of which have been turned to fit the reamed locating holes, and remain together throughout the rest of the processes. The cases are then racked in these cabinets for transporting to the next job which, in this case, is machining the mortised seats for the cylinders.

For this job the fixture shown in Fig. 7 is attached to the spindle nose of a Jones & Lamson machine. The case is located upon the fixture by a stud that passes through the central bore of both parts, is clamped by the swinging yoke *A*, and is located circumferentially with reference to the seats to be machined by the removable pin *B* which passes through a part of the fixture and enters one of the reamed holes in the case.

As here shown one of the cylinder seats is in line with the tools—having just been completed—and the other may be seen just beyond it. To bring the second seat into position before the tools the clamp *A* is loosened, the pin *B* is withdrawn and the case turned about its supporting stud. In the second position the pin *B* is transferred to another bushed hole in the fixture, where it again corresponds to one of the reamed holes in the case.

The first machining operation upon the cylinders is to rough-bore them upon a Baker vertical boring machine, which may be seen in Fig. 8. A special vise, with horizontal jaws operated by a right-and-left screw with handwheel, centers the bore of the casting under the spindle of the machine and holds it for boring. A McCroskey four-lipped boring bar, without a pilot, takes out the scale and leaves a fairly smooth bore about 0.045 in. under size. This bar is adjustable, so that the size may be maintained. But one cut is made at this time.

The next operation is to face off the upper flat surface

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square with the bore to receive the cylinder head, for which purpose the cylinders are placed, two at a time, upon expanding arbors in a Hartness flat turret machine. The machine and method of holding the work may be seen in Fig. 9, though the operation shown by that illustration belongs to a later stage. When they first come to this machine the cylinders are placed on the arbors the opposite way from that here shown, and a single roughing cut is taken over the surface of the top to remove the scale, after which the castings are subjected to a form of heat-treatment to season them and release any strains that may remain.

For this purpose a long furnace with a wide apron at both ends is employed. The chamber is open at both ends, and midway of its length is heated to a temperature of 1,000 deg. F. by gas burners. The cylinders are loaded on small wrought-iron racks, each holding four castings, and pushed slowly through the heating chamber.

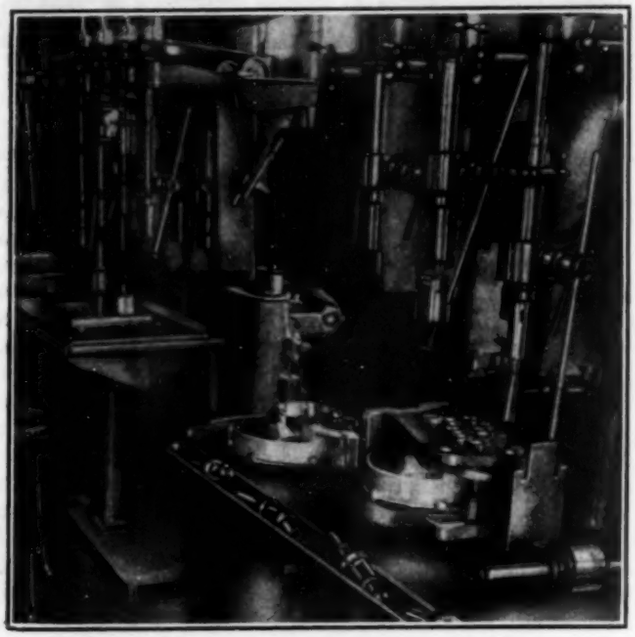

Fig. 5—Other drilling operations

Fig. 6—Truck to transport crankcases

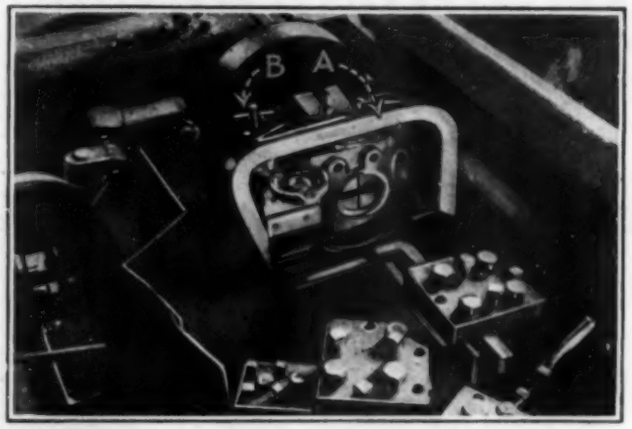

Fig. 7—Mortising the seat for the cylinder

The motive power to move the loaded racks is supplied by a small electric motor. Through a worm gear speed reduction it drives an endless chain that passes over sprockets in the apron at the entering end of the furnace. A loaded rack, placed by the operator on the apron, will be pushed by the chain into the furnace, and will be pushed further along by other racks entering behind it until there is a continuous row of them moving through the chamber.

The speed of the driving motor is regulated to allow the castings sufficient time in the heating chamber to be raised to a dull red heat. They will have cooled enough to lose their redness by the time the racks emerge from the opposite end of the furnace. The operator there removes the hot cylinders, transfers the empty racks to the apron at the entering end, and puts on another load of castings. The cylinders pass twice through the furnace, being allowed to cool to room temperature between passages.

After the cylinders are cooled they are sandblasted to remove the oxide formed in the furnace, and then return to the Jones & Lamson machine for the finishing cuts. These include a finishing cut over the upper end and two cuts, roughing and finishing, over the mortised end that makes a gas- and oil-tight joint with the crankcase.

Two sides of the turret of the machine shown in Fig. 9 are tooled for these latter cuts and one side for the finishing cut over the opposite end of the cylinder. Both jobs are carried forward as one operation. The diameter of the circular mortise where it fits into the corresponding recess in the crankcase is held closely to size, with a minus tolerance, only, of but 0.001 inch. Ring gages are used to test the size.

Several jig drilling operations follow, among them being four holes at the small end for the bolts that secure the cylinder to the crankcase; six holes at the larger end for the cylinder-head stud bolts; two holes for the valve-stem guides, and the counterbores for the

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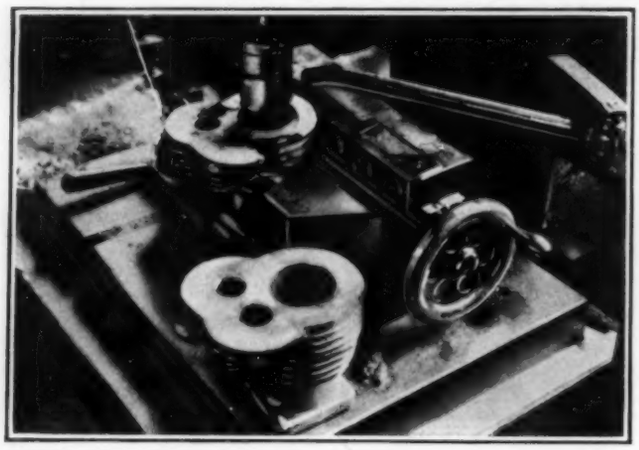


Fig. 8—Rough-boring the cylinder

valve seats. The intake hole, also, is drilled, counterbored and tapped, and the exhaust outlet is hollow milled to receive the exhaust pipe. The cylinder is then assembled with valve guides and intake nipple, and is sent to the plating room for a coat of nickel.

Upon their return from the plating room the cylinders are finish-bored in the Davis horizontal boring machine shown in Fig. 10. Of the six stud holes jig-drilled in the large end, two are now reamed to become the locating points in this, as well as in the final grinding operation on the bore. Two studs in the face of the chuck of the Davis machine enter these holes to align the bore at that end, while the circular mortise is centered by a slip bushing at the outer end of the chuck, which is made to swing open on a hinge for convenience in loading and unloading.

The two-lipped adjustable bar of the Davis machine removes $\frac{3}{32}$ in. of stock from the diameter of the bore, leaving about 0.012 in. to be taken out by the wheel of the Heald planetary cylinder grinding machine on which they are finished. Owing to the peculiar shape of the casting it has been found desirable to leave this amount of stock and make two operations of the grinding, as an attempt to remove a lesser amount in one cut causes distortion by reason of unequally distributed heat, thus slowing down the operation and making it more expensive than the two operations as now conducted.

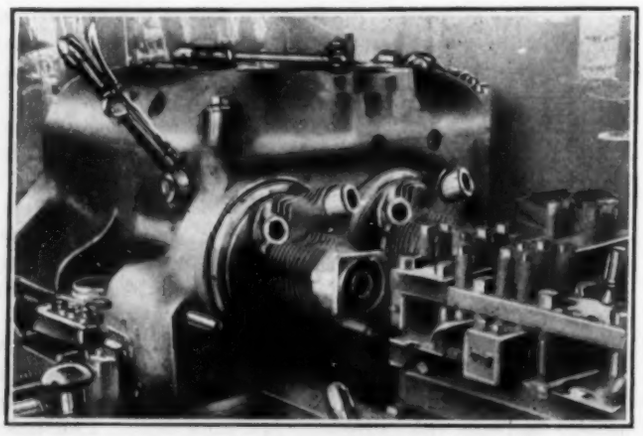


Fig. 9—Mortising seat on cylinder

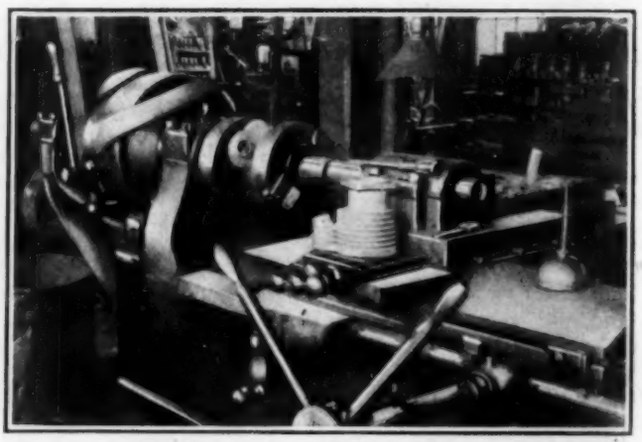


Fig. 10—The finish boring operation

Ample time is allowed between grindings for the castings to cool normally to room temperature.

The grinding machine operator makes the final inspection upon the cylinders before putting them into his machine. If the casting is defective in any way, having gotten by previous inspections because of defects brought to light by the machining operations, he marks it with red chalk, indicating that it is to be scrapped. He is provided with gages to test the accuracy of previous machining operations, and, if he finds error in any respect, marks the casting with blue chalk for correction.

The gage with which he tests the bore of the cylinder embodies the same principle as those previously shown in connection with other operations. A light base of hardened steel has two parallel lugs, or feet, spaced 120 deg. apart circumferentially and accurately ground to the same radius as the bore of the cylinder. At the third point of contact with the cylinder wall is the measuring spindle of the gage, bearing upon an amplifying lever that transmits its movement to the pointer of a dial gage.

The lugs are long enough to align the tool with the axis of the cylinder bore when it is pushed into the latter, and any departure from roundness or parallelism will be shown, greatly magnified by the indicator, as the tool is turned about or pushed through the bore.

The reason that automobiles are cheap in the United States is that each man in the industry produced ten automobiles last year. In some other countries it takes three men to produce one car.

An all-metal German flying boat, built by Dornier and having 2 Rolls-Royce engines of 650 hp. each, carried 53 people in a series of flights over Lake Constance, at a maximum speed of 125 miles per hour.

Chromimum plating on the cutting edges of tools works well where the cut is continuous, rather than intermittent. This makes the practicé better adapted to turning, boring and reaming rather than to planing, shaping or milling. It is just possible that chromium plated tools may rival the diamond for boring bronze bushings or aluminum crankcases.

Gaging and Interchangeability

By Frank C. Hudson

Gages necessary to secure interchangeable work — Confusion of "limits" and "tolerance"—Advantages of unilateral tolerances in manufacturing—Difference between selective and interchangeable manufacture

GAGING systems, like systems of efficiency, are not popular in some shops, because they have not been properly planned to suit the particular shop or have not been installed and operated with the necessary knowledge and tact. Gaging systems can be either simple or elaborate, inexpensive or costly, according to the degree of interchangeability desired. But no kind of interchangeability can be had without some sort of a gaging system, which means that no real manufacturing can be done without careful attention to the methods used in measuring, or gaging, the parts. If we could make parts out of metal as easily as we can draw them on paper and secure the correct sizes as easily as we can mark dimensions on the drawing, all question of interchangeability would vanish. But while it is easy to mark a hole 2 in. on a drawing, it is next to impossible to secure one exactly 2 in. in actual practice. Drills and reamers may cut oversize, the metal may stretch under the cut in a light piece of work and close in again after the hole has been finished. If the hole is bored with a single point tool or if it is ground, there is pretty sure to be some slight variation due to the operator. The only safe bet is that it *will not* be exactly 2 in. The variation may be only a small fraction of a thousandth of an inch, which in some kinds of work may be negligible. But in order to have work go together easily and satisfactorily in assembly, it is necessary that the variations be kept within known limits.

> There are two great advantages in using the unilateral system of tolerances. One, that a standard gage can always be used for the "go" gage. The other, that it is easy to remember that all tolerance must be in the direction of removing metal

The growth of gaging led to the use of new terms, some of which have been used indiscriminately and are consequently confusing at times. The terms "limit" and "tolerance" for example are frequently used interchangeably. The best usage, however, makes them distinct in order to avoid confusion. "Limit" is applied to the permissible variation in total dimension. If a piece can be used with a variation of 0.002 in. above basic size, we say the limit is from 2.000 to 2.002 in. The "tolerance," however, is 0.002 in. or the greatest variation from the basic size that can be tolerated. When stated as above, the variation is known as the "unilateral" or one-way tolerance.

There is also another way of stating limits and tolerances that is still being used in some shops, although the tendency is strongly toward the unilateral tolerance both here and abroad. The older way is known as the "bilateral" or two-way tolerance, since it gives a permissible variation both above and below basic size. This older way of giving limits would have been 2 in. plus or minus 0.001 in. The total tolerance would still be 0.002 in., but it could be divided above and below the basic size. The limit would be 1.999 to 2.001 in. instead of 2.000 to 2.002 in., as in the first case.

Strictly speaking, the older method of bilateral tolerance will not give interchangeable work, because it will pass a hole 1.999 in. and a shaft 2.001 in. which evidently will not enter a 2-in. hole, except by forcing. With the unilateral tolerance the largest shaft will go into the smallest hole. The unilateral tolerance method would give such dimensions as 2 in. + 0.001 — 0.000 for the hole, and 2 in. + 0.000 — 0.001 for the shaft. And while the unilateral method may seem to cut the tolerance in two, in reality it does nothing of the kind, because the greatest looseness in either case is 0.002 in.

A plus tolerance on the shaft and a minus tolerance in the hole cannot be used in strictly interchangeable manufacture. Shafts that are above basic must be assembled with holes that are also above basic, and this is "selective" and not interchangeable manufacture. True, there are many cases where this is the most economical method, but let us call it by its proper name and not delude ourselves into thinking it is interchangeable.

What we call "standard hole" practice has been common for years in most shops, on sizes where the hole is finished by reaming. This practice was followed because it was easier to vary the shaft that entered the hole, than to adjust or grind the reamer.

There are, however, places where the shaft is made standard. In some instances there are several kinds of fits on the same shaft, as in some printing and binding machinery. Others, notably the Fiat Co. of Italy, consider that the new methods of finishing shafts such as by centerless grinding, make the standard shaft more desirable than the standard hole.

In the unilateral method of tolerances the basic dimension is the upper limit for the shaft and is the lower limit for the hole, and all tolerance must be *in*

the direction of removing metal. This makes it easy to remember. The receiving part has its tolerance *above* basic while the tolerance of the entering part is *below* basic.

Some engineers contend that by the system of unilateral tolerance the life of reamers is reduced by not making them usable after they wear below the basic size. As a matter of fact, however, reamers are made above basic size when new, and can easily be made as much above basic as the tolerance demands. This method will allow all the permissible wear to be above basic instead of dividing it both above and below. Reamer cost is not increased by the unilateral method.

Running fits and force fits require different limits (not necessarily different tolerances) than parts that fit into each other and do not move. Force fits require an interference of metal—the shaft must be somewhat bigger than the hole. These exceptions to the use of basic *plus*, for holes and basic *minus* for shafts in no way affect the desirability of the unilateral tolerance.

Common, ordinary horse sense should prevail in all work, whether it is designing, machining, or gaging. If it is easier to vary the hole than the shaft, or whatever goes into it, that is best for that particular job. This may frequently be true on holes that are beyond what we usually consider to be reamer sizes. But it in no wise affects the desirability of using the "standard hole" practice on most work any more than it discounts the advantages of unilateral tolerances, from basic dimensions, as a standard of practice.

When it comes to the particular tolerance to be set for work of different kinds, practice differs widely according to the kind of work being considered. A committee of the A.S.M.E. has been at work for several years gathering data from many sources as to tolerances actually used by leading firms for various purposes. This committee has neither the power nor the desire to force the adoption of any special tolerances. But as the tolerances it has collected and tabulated are based on the actual practice of many manufacturers, it believes that it will be to the advantage of manufacturers in general, and to the machine building industry of America in particular, to study these tolerances and to make them standard in their own shops. With standardized tolerances, it is easily possible for work to be done by contract with a clear understanding of what is required in the way of accuracy and fits. All of which will add to the stability of our own industries and to our grasp on the leadership in large scale manufacturing. Disputes, litigation and loss by both sides could be eliminated.

The Executive's Power to Contract for Work

By Leslie Childs

THE question of the power of a president or other corporate executive to bind his company by contract has been the cause of much litigation. But, since each case of this kind has been decided in the light of its facts, the subject cannot be covered by a hard and fast rule.

As a general proposition of law, the implied authority of a corporate executive to bind his company is limited to such matters as come within the ordinary scope of the business. And any contract by a president, general manager, or other executive, which goes beyond this, must usually be approved by his board of directors, or stockholders, as the case may be, before the company will be bound. A recent West Virginia case will serve to illustrate the points involved.

A manufacturing company was organized for the purpose of making a certain kind of jack. The president of the company had the usual authority of such an executive in the management of his company's affairs. The president, however, entered into a contract with a wagon company, whereby he undertook to obligate his company to manufacture a convertible wagon, on a royalty basis. By the terms of this contract, the manufacturing company agreed to produce at least 10,000 wagons each six months, to sell them at a designated price, and to pay the wagon company 15 per cent of the gross sales.

This contract was signed by the president of the manufacturing company, without any special authority from his board of directors or stockholders. Soon after the signing of the contract, the manufacturing company got into financial difficulties, and was unable to comply with the contract. The wagon company thereupon brought action for damages.

In defense of this action, the manufacturing company denied the validity of the contract on the ground that its president had no authority to bind it by a contract of this character. The trial in the lower court, however, resulted in a decree in favor of the wagon company. From this the manufacturing company appealed, and the higher court reversed this decision, and in passing upon the validity of the contract said, in part:

"The president of the defendant corporation had no inherent power to make contracts on its behalf. While the general manager of a corporation is by law vested with greater powers in regard to making contracts than the president, his inherent authority to contract for his principal extends only to such matters as come within the scope of its ordinary business.

"There is no evidence to show that the company was engaged in any other business than the manufacture of the jack before the time the contract in question was made. And there is no evidence that the directors contemplated the manufacture of any other article.

"To comply with the contract for the manufacture of 20,000 wagons a year would have meant a complete change in the plant and machinery, as well as in the nature and scope of the defendant's former business. And it is not to be presumed that the president's authority as general manager could be extended to making contracts rendering his principal liable for royalties of $18,000 per year for a period of seventeen years. No director or stockholder could reasonably have anticipated such a contract at the time of his employment."

In accordance with the foregoing reasoning, the court held that the wagon company was not entitled to recover under the contract. Thus, it is obvious that care should be exercised in contracting with a company, through the medium of its executive officers alone. At any rate, anyone so contracting should make sure of the authority of such officers to sign a binding contract.

Applying Electrical Equipment to Production Machinery

By Robert Corey Deale
Electrical Engineer, Niles-Bement-Pond Co.

Push-button control of large lathes—Traverse motors and their control—Comparison of alternating and direct current lathe equipment—Drive for screw machine—Special railroad lathes

FULL automatic control from push-button stations located at the carriages, headstock and other convenient positions is frequently desirable for very large or very long lathes. Connections are made between the controller and push buttons by trolley wires mounted on the bed of the lathe. The carriage of a lathe swinging 113 in. over the ways is shown in Fig. 82 to illustrate full push-button control. There are buttons for running the spindle in one direction or the other; for stopping it; for raising or lowering the spindle speed; for traversing the carriage in either direction; or for feeding it in either direction. There is another button by means of which the entire machine may be stopped in such a manner that it cannot be restarted from any other station. All the other controls of the main motor are duplicated, and hence the spindle may be started from one station and stopped from another, or the speed increased at one position and lowered from another. There is an automatic controller for the main driving motor, and others for each traverse motor. When a d.c. driven lathe is so operated, a motor-operated field rheostat, controlled from push buttons on the carriages, may be used to increase or decrease the speed of the driving motor and, consequently, the spindle.

The carriages are usually fed through gearing from the main driving motor, so that the feed is definitely related to the revolutions of the spindle. On some of the larger lathes, however, a motor mounted on the carriage is used for both feed or traverse. When this construction is used, the feed is independent of the spindle speed, and two carriages may be fed at different rates. The feed motor runs only when that particular carriage or its slide is being fed. The amount of feed may be varied either by gear changes between the motor and feed rack (or stationary feed screw) or by varying the speed of the motor, when d.c. motors are used. When such a system is employed, the control equipment should be designed so that the feed motor cannot be started until the main motor comes up to speed. It may also be desirable to provide for reducing the speed of the feed motor, should the main motor be overloaded. In this way the machine would protect itself against excessive feeds.

While alternating current is very extensively used, particularly in the smaller shops, and in repetitive shops, such as those of the automotive industries, nearly all large machine shops have either part or all of their power furnished as direct current, because of the fact that practically all a.c. motors have only one fixed speed. Motors are made with several fixed speeds, but the speeds are practically limited to four or six, and are determined by the numbers of poles of the motor. In addition they are made only in the smaller sizes and are seldom carried in stock. As a result, when only alternating current is available, the machines are usually driven by a constant-speed motor with gear changes for obtaining the desired spindle speeds. Fig. 83 shows how a standard squirrel-cage induction motor may be mounted on a 27-in. lathe so as to blend well with the design of the machine. A push button, which may be seen if the cut is closely examined, is used to jog the automatic controller to bring the gears in line when changing speeds. Dynamic braking cannot be secured with induction motors, which are the only a.c. motors suitable for machine tool use. Consequently, the machine must coast to a standstill, or a friction clutch must be introduced between the motor and spindle. A mechanical brake can also be employed to stop the motor when the power is shut off. None of these expedients are desirable, therefore, direct current is used wherever possible.

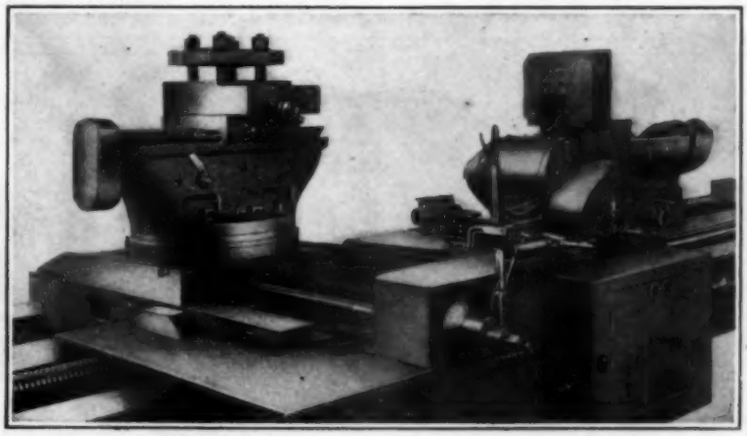


Fig. 82—Push-button control station on the carriage of a 113-in. lathe

The tenth article. The eleventh will appear in an early issue.

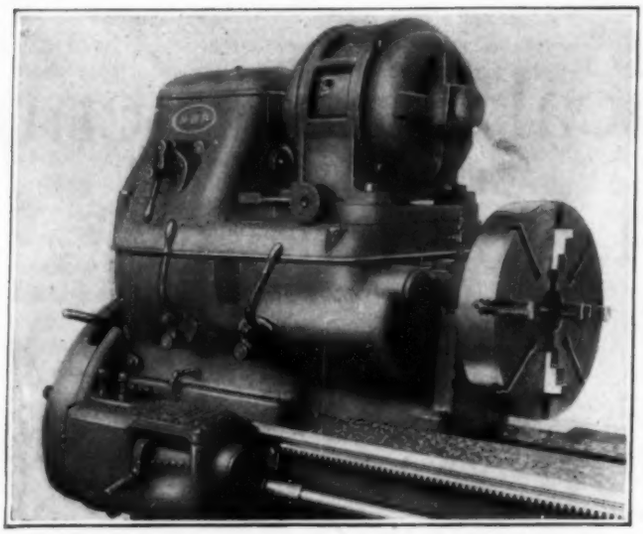


Fig. 83—Squirrel-cage motor driving a 27-in. lathe

In Fig. 84 may be seen an extra-heavy 72-in. lathe that was recently designed for steel mill use, particularly for roll turning. Power is supplied from a 75-hp. adjustable-speed d.c. motor with a full-automatic controller. A spline-shaft-operated master switch, similar to that shown in Fig. 77, gives full control of the driving motor from the carriage. In addition there is a push button mounted on the carriage which makes it possible to slow down the driving motor momentarily whenever it is desirable. The carriage traverse motor, which is heavily compounded, may be seen in Fig. 85 mounted under the rest. This motor has a reversing drum switch and has a ballast resistor always in circuit. The tailstock, shown in Fig. 86, is equipped with a small compound-wound motor for both traversing the tailstock and clamping it to the bed. When a clutch is thrown to connect the motor to the clamping mechanism, an auxiliary switch simultaneously connects an extra resistance in the armature circuit to keep the motor from being injured when it is stalled on the line. A reversing drum controller with one step of acceleration is used for rapid traversing and clamping.

Special forms of the lathe, such as automatic lathes, turret lathes, screw machines and similar machines usually have so short a bed that there is little advantage in having carriage control of the motor. In addition, as these machines are usually small and carried in stock, for manufacturing reasons it is desirable to make them all for constant-speed motor drive, so that d.c. or a.c. motors can be used without change of the machine. For these reasons, few machines have the full advantages of the d.c. drive. An automatic controller, started and stopped by a push button as shown on the screw machine represented in Fig. 87, is usually provided, but the driving motor runs constantly and the spindle is started and stopped by means of a friction clutch. Should an adjustable-speed motor be used, its speed is usually set by a small field rheostat also located on the headstock. Power rapid traverse may be provided, but is seldom necessary except on the larger turret lathes because of the light weight of the carriages and the short distances traversed.

Locomotive and car axle lathes are fundamentally the same as the small, low-swing manufacturing lathe, and usually take the same form of electrical equipment. Center drive axle lathes take the same equipment as standard lathes with the faceplate drive.

Locomotive driving-wheel lathes and car-wheel lathes are heavy-duty special-purpose machines and are somewhat special in their electrical requirements. Direct current machines have an adjustable-speed shunt-wound main driving motor, with an automatic controller operated by push buttons and with a separate field rheostat for adjusting the speed. The traverse motor is a constant-speed compound-wound type, controlled by a reversing drum. Alternating current machines usually have a wound-rotor induction driving motor and a high-resistance rotor, squirrel-cage traverse motor. The controller for the driving motor is an automatic one with two three-button control stations, while the traverse motor has a reversing drum control. A standard squirrel-cage driving motor could be used, but such a motor would be difficult to start with the tools in the work, and could not be slowed down when it is necessary to pass a hard spot in the wheel. When used wheels are being refinished, small portions of the circumference are apt to be locally hardened, usually because of the slipping of the wheel on the track. It has been found necessary to provide means by which the speed of the lathe may be momentarily reduced. This reduction is accomplished, in the case of d.c. motors, by short-circuiting the field rheostat and inserting armature resistance. The motor armature may also be paralleled, but this is not necessary nor usual. A.c. motors are slowed down by inserting resistance in the secondary or rotor circuit.

Direct-current wheel-lathe controllers provide start,

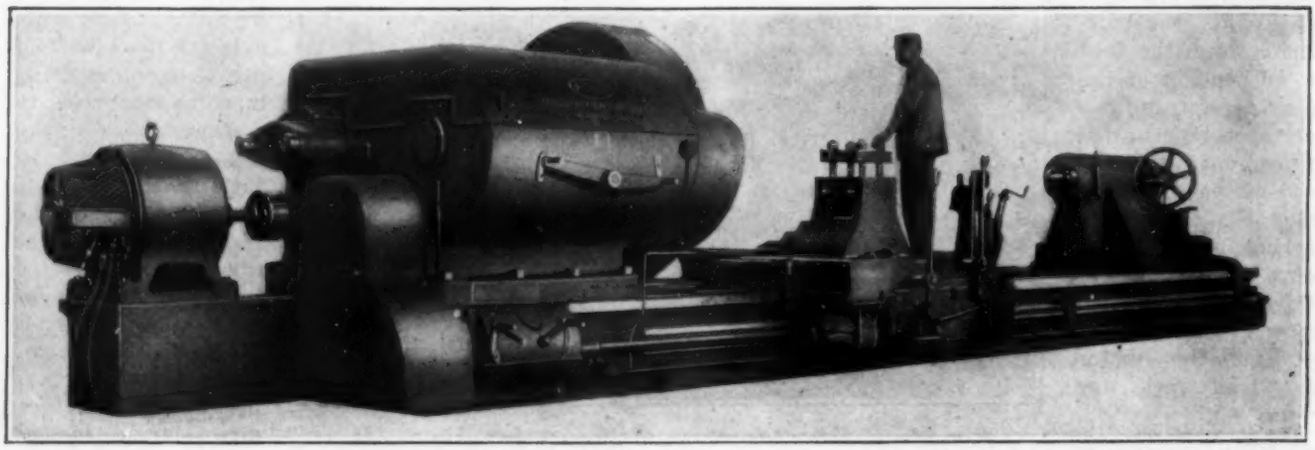
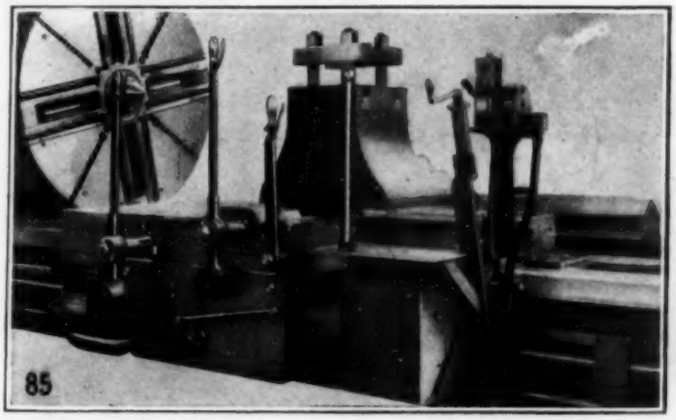


Fig. 84—Extra-heavy 72-in. lathe with electric drive



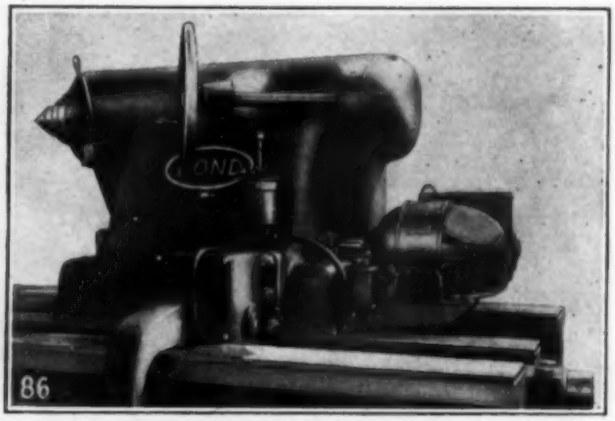


Fig. 85—Carriage traverse mechanism of the lathe shown in Fig. 84. Fig. 86—Tailstock traverse mechanism of the same machine

dynamic-braking stop, acceleration, and slow down by means of contactors controlled from one or more push-button stations. In addition a knife reverse switch is provided to allow the machine to be reversed in an emergency, such as the sticking of a tool in the work. Full-automatic reversing controllers may be secured but they are unnecessary and are seldom used. Two push-button stations are usually provided, one mounted on a stand back of the operator's position, and one at the back of the machine for use when adjusting the drivers. The field rheostat is also mounted back of the operators.

Alternating-current controllers are similar in make up except that no speed variation or dynamic braking is possible.

It is believed that some form of pendent switch, which could be operated by the operator without making it necessary for him to withdraw his attention from the tool, would be much preferable to the present push-button station which is generally located in back of the operator. Such a pendant switch, swiveled from the stationary head, could be swung out of the way while the machine is being loaded and would be very accessible to the operator.

The traverse motor may be controlled by a reversing drum controller or by a simple automatic panel, as may be desired. The automatic controller has the advantage that limit switches may be used with it to limit the motion of the movable head. The traverse motor frequently is connected to the traverse gearing through a friction clutch, so that the motor may first be started in the proper direction, and then the actual traverse controlled by the clutch. This does not seem to be absolutely necessary, although it adds another element of safety to the machine.

Driving-wheel lathes at times have a small boring attachment as shown in Fig. 88 for boring the pin holes for the drivers or quartering the wheels, as it is called. This attachment is usually provided only on lathes for the smaller shops, where there is not a sufficient volume of work to warrant providing a separate quartering machine. When direct current is available a shunt-wound adjustable-speed motor is used, with a field rheostat mounted on the quartering attachment itself, and some simple form of automatic or manual starter which provides simply for the starting or stopping of the motor. When a.c. motors are used, a standard squirrel-cage motor with an "across-the-line" automatic starter makes the most satisfactory equipment.

The quartering machine, shown in Fig. 89, is used in the larger shops where there are enough wheels to be quartered to keep such a machine busy. Each quartering head has its own motor and control, which are the same as those used on the quartering attachment described above. In addition there is a traverse motor which may be connected to either head by clutches. For d.c. operation a heavily-compounded motor is used, while a high-resistance rotor, squirrel-cage motor is used on a.c. circuits. In either case a reversing automatic controller is used. Limit switches should be provided to prevent the heads or boring bars from being traversed too far.

A journal lathe is used for truing the journals of locomotive axles, and in addition it may be equipped with quartering attachments. The electrical equipment for the quartering attachments, and for traversing the heads, is the same as for the quartering machine shown in Fig. 89. In addition the machine has a motor for driving the faceplate. A shunt-wound, adjustable-speed

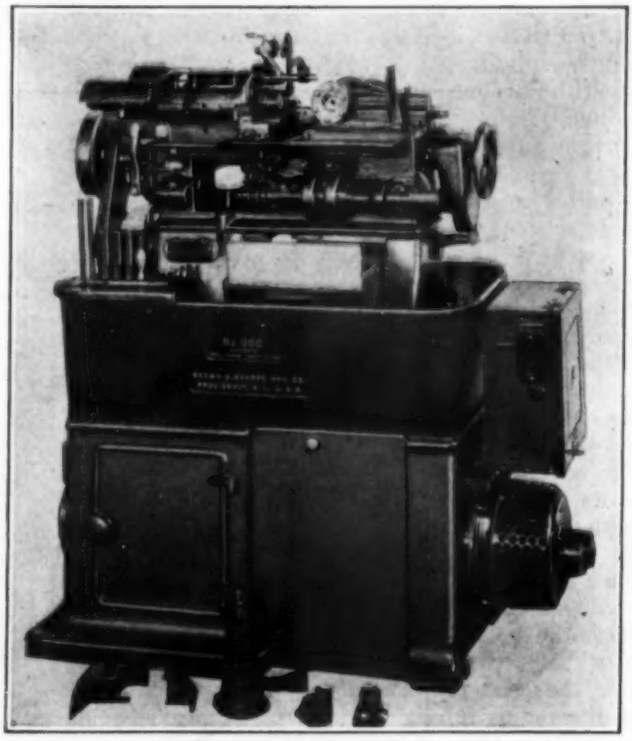


Fig. 87—Motor-driven screw machine

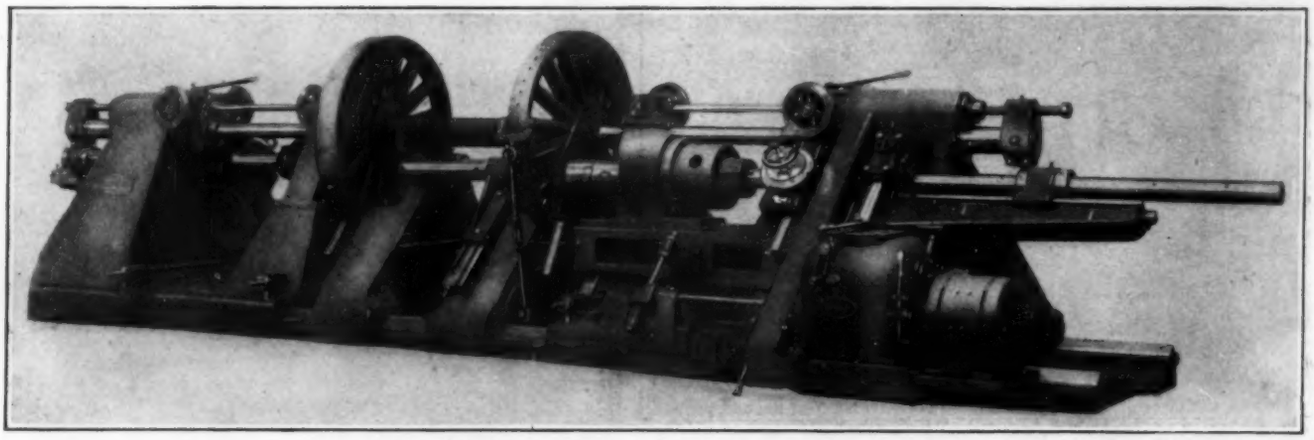


Fig. 89—Locomotive-wheel quartering machine

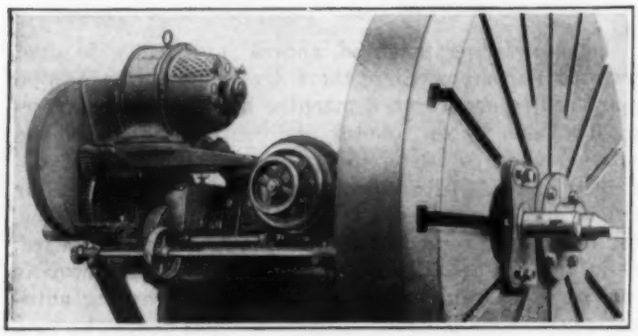


Fig. 88—Motor-driven boring attachment on wheel lathe

motor is used where direct current is available, with an automatic controller operated by means of a push button and a field rheostat mounted on the headstock.

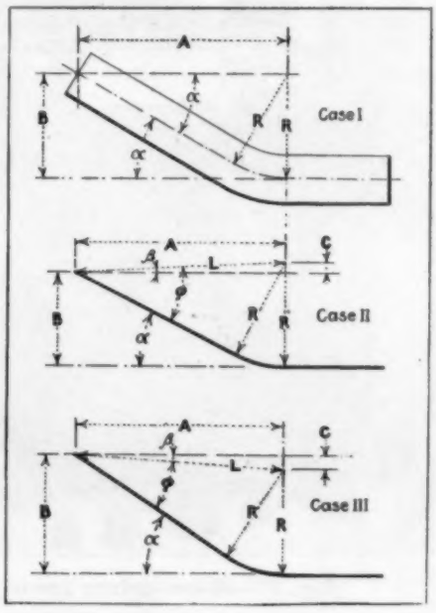
A standard squirrel-cage motor with an automatic resistor- or compensator-type non-reversing starter is used on a.c. circuits.

An ingot slicing lathe has no unusual electrical features. For direct current a shunt-wound adjustable-speed motor, with full-magnetic non-reversing, dynamic braking controller, with a push-button station located on the head, and a separate field rheostat, should be used. For a.c. circuits a squirrel-cage induction motor, with an automatic, non-reversing controller of the compensator- or primary-resistor type should be used. With either, a reversing knife switch would be desirable to reverse the motor in order to back out the tools after they have been left in the cut because of the operation of the overload relay, or for any other reason. Traverse motors and controllers similar to those on standard lathes may be provided.

General Solution of a Trigonometric Drafting Problem

By Edward Heller

TO FIND the angle a in the problem shown in case I when A, B, and R are given is very simple. But when the problem is varied slightly as shown in cases II and III, most shop men and many draftsmen get confused and go about its solution in a round-about way. This kind of a problem can be worked down to a general formula, the solution of which is simple. In case I, the center of radius R is in line with the left-hand end of the center line at its highest point; i.e., $R = B$. In case II, the center of radius R is above the height B, while in case III, the center of the radius R is below the height B.



The first step in the general solution is to find C. $C = B - R$ or $R - B$ as the case may be. Then

$$\beta = \tan^{-1}\frac{C}{A}$$

The next step will be to find L, as follows:

$$L = \sqrt{A^2 + C^2}$$

With L known we can now find $\lambda\phi$ thus

$$\phi = \sin^{-1}\frac{R}{L}$$

and $$a = \phi \pm \beta$$

In case II, the minus sign is used, while in case III, the plus sign is used.

By combining all the calculation in one formula, we obtain the following:

$$a = \sin^{-1}\frac{R}{\sqrt{A^2 + C^2}} \pm \tan^{-1}\frac{C}{A}$$

For case I, $C = O$; therefore, $a = \sin^{-1}\dfrac{R}{A}$

A concrete problem of case III will be used to demonstrate the above formula.

Let $A = 3\frac{1}{2}$ in., $B = 2$ in., and $R = 1\frac{3}{4}$ in. Then $C = 2 - 1\frac{3}{4} = \frac{1}{4}$ in.

$$\text{and } a = \sin^{-1}\frac{1\frac{3}{4}}{\sqrt{3\frac{1}{2}^2 + \frac{1}{4}^2}} + \tan^{-1}\frac{\frac{1}{4}}{3\frac{1}{2}}$$

$$= \sin^{-1}\frac{1.750}{3.5089} + \tan^{-1} 0.07142$$

$$= 29°50' + 4°5' = 33°55'$$

Forging Two Unusual Parts

Replacing a difficult casting with a forging—Forming in one operation—Methods used—Hot drawing a very heavy shell

THE MOTOR end shields, or fans, used on the Westinghouse No. 510 A and No. 514 railway motors were formerly cast of malleable iron. On account of the rigid service requirements of these parts, however, it was found that 50 per cent of all part castings were rejected for defects, and as a consequence the steel fans shown in Fig. 1 were substituted. These parts are being made at the East Pittsburgh plant of the Westinghouse Electric & Manufacturing Company.

The weight of steel in the rough forging is approximately 32 lb., and the distribution of the metal must

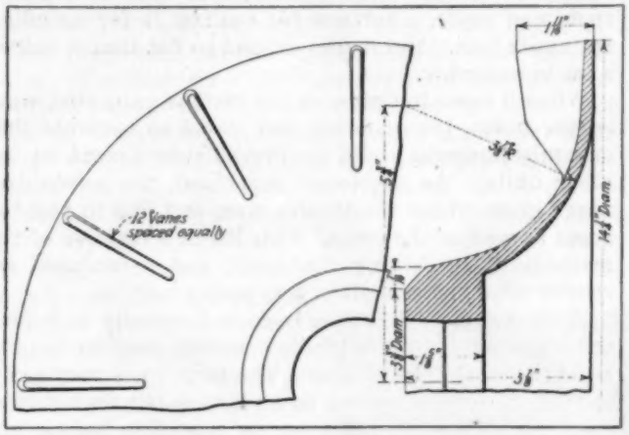


Fig. 1—Drop-forged motor end shield

be such as to permit a balance of the fan within 6 oz. The fan has 12 deep vanes equally spaced about its face, and the greatest thickness of the hub is 1⅝ in. The forging is completed in two heats on a single set of forging dies. In Fig. 2 is shown the forging completed just before removal from the dies.

Shearing the Plate

The forging blanks are made from boiler plate steel 1 in. in thickness. The first operation consists in shearing the boiler plate into 12½-in. strips. For punching out the 12-in. blanks a heavy-duty punch press is used, and the blanks are punched hot. The size of forging blank is shown in Fig. 3. The tip, shown at *A*, is left on the blank for holding during the heating and forging operations.

The blanks are heated in an open oil furnace using oil at 150 lb. pressure located alongside of the hammer. The only available steam hammer for the forging of this part was one of 5,000-lb. capacity, but it was later determined that a considerable saving could be made with an 8,000-lb. hammer by making it possible to reduce the number of blows.

The rough forging is done on the first heat with 22 blows of the hammer, after which the forgings are returned to the furnace. A total of 45 blows is required for completing the forging in both operations. Both roughing and finishing forging operations are accomplished with the same set of dies. These dies are of chrome-nickel alloy steel, and are expected to produce about 6,000 forgings during the life of the die.

The Radiola loud speaker shell, shown in Fig. 4, is drop forged from ⅛-in. soft-steel plate. The first operation consists in hot blanking, the blanks being 9 in. in diameter.

In the second operation the blank is formed in a set of drop-forging dies into a shell with tapering sides

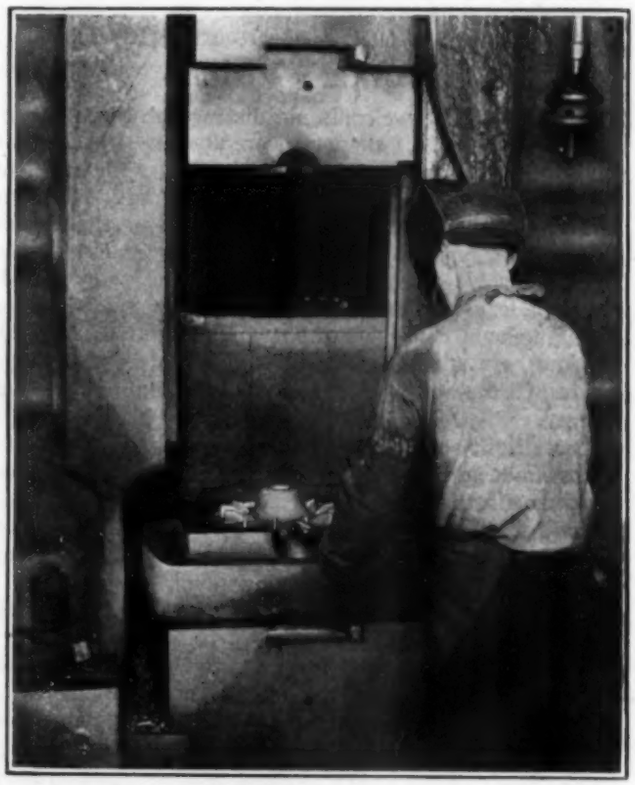


Fig. 2—Forging the motor end shield

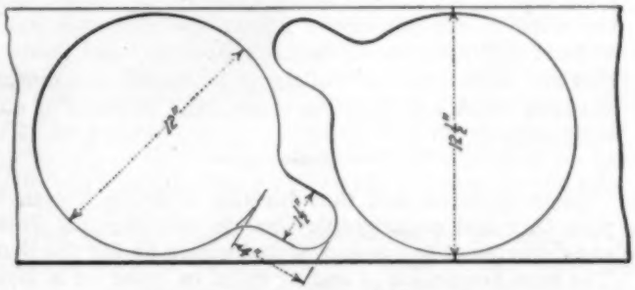


Fig. 3—Layout of blanks

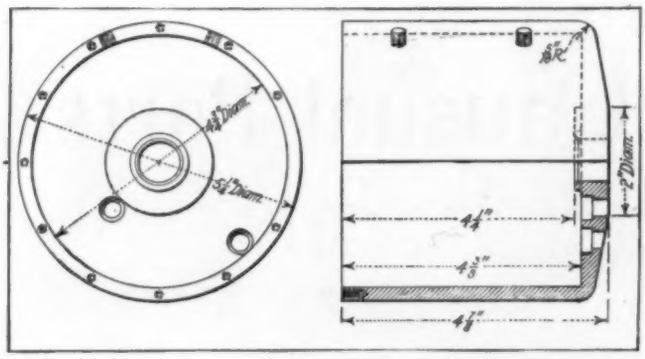


Fig. 4—A hot pressed Radiola shell

3¾ in. deep and 7¾ in. in diameter at the top. The operation is done on a 3,300-lb. hammer, and requires about 16 blows to form the shell.

The flash is next trimmed from the tapering shell, and the parts are sand blasted. The final operation consists in straight-drawing the shell to the finished dimension. The forging and drawing dies are of special alloy steel.

Shadows May Aid or Hinder the Worker's Vision

OFTENTIMES we could not distinguish three-dimensional objects if shadows were absent. Usually in a well-designed lighting system light comes with sufficient predominance from the nearest lighting-unit to provide the necessary shadow-effect. Besides this, in the case of three-dimensional objects, the various surfaces of the objects receive different amounts of light, thus providing a helpful shadow-effect. However, as one passes through shops, conscious of lighting as related to vision, shadows are often found hindering vision, causing a waste of time and energy and, also, providing potential danger.

Local light-sources can be so placed as to eliminate these shadows but they are often used so carelessly as to augment the difficulties. A punch-press or a drill press, for example, is often found to have a shadow at the most important area. A worker's head, body, or hand is often casting a shadow upon the work. It requires little more than a consciousness of the condition to correct this evil.

Such conditions are not confined to the smaller shops, for they are found in the largest machine shops of industries widely known for their efficient layout, for their time-saving methods, and effective modern practices. Still, owing to the general lack of consciousness and knowledge of the details which relate to lighting and vision, waste, annoyance, and danger are unknowingly tolerated. Careful investigations have shown that the waste is not only one of human energy but actually of time and therefore of dollars. Accuracy and production are decreased and spoilage is increased by harmful shadows which are found on every hand in many of our work-places.

Some concerns find that instead of firing a man it pays to spend considerable time in shifting him from one department to another to find where he fits the best. The men appreciate it and it helps to build up a loyal organization.

Seen and Heard

By John R. Godfrey

Unexpected results from new methods

THE best of planning frequently slips a cog. Usually we get a little less than we counted on when we did the planning. Sometimes, however, we find a chromo hidden away that we didn't count on. If we are honest with ourselves, we admit that we overlooked a bet and therefore tuck the experience away for future use. Too often we kid ourselves, and others, into believing that we knew all along how matters would turn out, and that the outcome is simply another evidence of our great wisdom.

A case in point was the use of a large surface grinding machine for finishing the bases of devices that consisted of several units assembled on them. The grinder did all that was expected of it in the way of saving time. The magnetic chuck greatly reduced the time of attaching the work on the table.

A cut over the bottom of each base took off the high spots and made a surface for seating it for grinding the upper face. And it was ground so flat that it helped a lot in assembly.

When it came to lining up the various units that went on the bases, the grinding was found so accurate that any misalignment could be immediately traced to the other units. As previously machined, the assemblers never knew where the trouble was, and had to test the bases as well as the units. This led to a revision of the methods of machining the units, and so reduced assembly time and rejections to a marked degree.

A somewhat similar case happened recently in testing out a special, multiple-spindle grinding machine for finishing several holes at once. The tests were very satisfactory from the grinding point of view but they showed that the holes were not properly spaced in boring and were not parallel. Being satisfied that the grinding spindles were right, the boring machine came in for an overhauling, and a much better product has resulted.

The Metallurgist—From an Engineer's Viewpoint

By Peter Hagen

THERE was a time not so far back in the history of the designing engineer, when he got out his slip-stick, log-books, etc., and designed his product without very much regard to shop methods, shop facilities or commercial stock practices. He felt he was an engineer who designed something, which from a purely scientific viewpoint was the ideal. Today he analyzes each phase of his design in terms of shop operations and equipment, and of commercial material and sizes. His dimensions are expressed in the manner most applicable for direct shop production.

The metallurgist is sometimes just a little loath to get away from this purely scientific viewpoint. But how much greater would his service be, if instead of offering a technical analysis of the problems presented to him, he would give the answer expressed in the language of production, so that it could readily be understood by the engineer.

Making the Rotor Member for a Rotary Pump

Rotor is made like a herringbone gear, but with sharper lead-angle—The helices are machined on a shaper—Types of tools for roughing and finishing—A special dividing and spiral fixture

THE Kenney Manufacturing Co., of Boston, make rotary pumps of the general type designated as geared pumps, of which the pumping members, or rotors, are distinctly in a class by themselves. In order to show the shape of these members to the best advantage, two photographs are presented, Fig. 1 showing a pair of 16-in. rotors in approximately the relative position they will occupy in the pump case, and Fig. 2 a pair, somewhat smaller in diameter, mounted upon the studs of a stand on which they are fitted and inspected.

The rotors are made of bronze or cast iron, and in sizes ranging from 3 in. to 16 in. in diameter. Notwithstanding their peculiar shape, a pair of them will roll very smoothly together, like a pair of gears, although the gear action is not depended upon as a driving factor. Both rotors are keyed to shafts that extend through stuffing boxes in the side of the pump case, and are geared together outside the case by a pair of spur gears. The shape may be likened to that of a herringbone gear in which the lead is so much shortened that the rotor might justly be classed as a worm—if there *could* be any such thing as a right- and left-hand worm. It is made in two pieces, of course, and a string of right-hand or left-hand sides placed end to end on an arbor, as is done in the process of manufacture, has the appearance of a worm of abnormal length in proportion to its diameter. The method of manufacture is peculiar, though logical. All of the work of machining the teeth is done on a shaper, upon the knee of which is mounted a special fixture, resembling in principle the dividing head of a milling machine. The circular, graduated base of the fixture allows it to be swivelled to any desired angle in a horizontal plane, and it is traversible along its base in the direction established by the angular setting, by a lead screw. It is provided with a worm and worm-wheel dividing-mechanism, with index plates, to divide the circle into any desired number of parts, and, finally, the worm of the indexing mechanism may be geared to the lead screw to govern the lead of the helix.

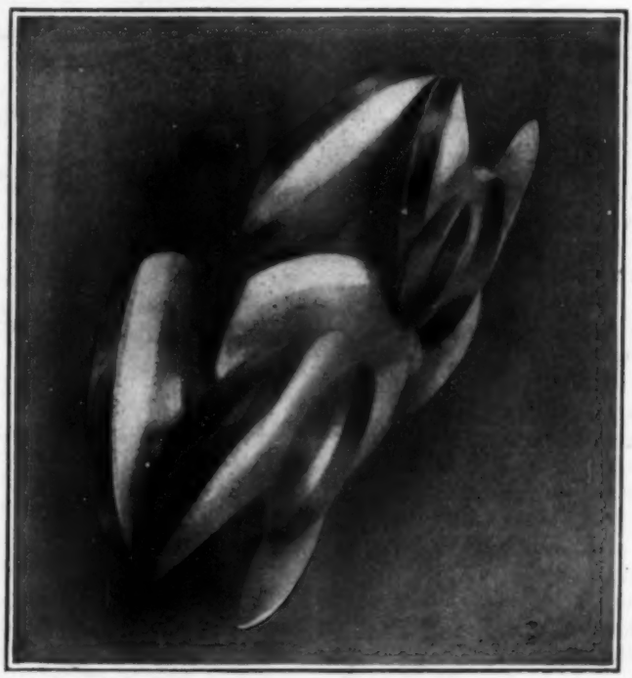


Fig. 1—A pair of 16-in. rotors

The shaper is a standard machine is every respect, except that the vertical toolslide has been removed from the ram and a special toolholder substituted therefor, which has no vertical adjustment. The special holder has the usual clapper-box, studs and straps to hold the tool, and, because of its having been made to take the place of the regular toolslide, it can be swivelled in a vertical plane, though that adjustment is never used. The reciprocating feed-lever and the pawl of the shaper, instead of actuating the cross-feed screw of the knee, are applied to the worm shaft of the fixture.

The rotors are bored, reamed, faced and turned in chucking machines or engine lathes, according to size and quantity. The smaller sizes are machined as plain disks, while the teeth of the larger sizes are cored in the casting in order to save the time of stocking. After having the keyways cut in the bores, they are mounted, four or more at a time, on the mandrel of the fixture.

The work mounted for planing the teeth is shown in Figs. 3 and 4. Four right-hand halves(in this case) are keyed to the mandrel and are further secured by a nut at the small end of the mandrel. The indexing mechanism is set to space three divisions, and the lead screw is geared to the ratio necessary to generate the desired helix. There is no vertical movement of the tool during the operation, such adjustment in this plane as may be required when setting up the job, being accomplished by raising or lowering the knee on the column.

The cutting tool is of the shape of a parting- or cutting-off tool, having a width equal to the width of the flat at the bottom of the thread to be cut (this

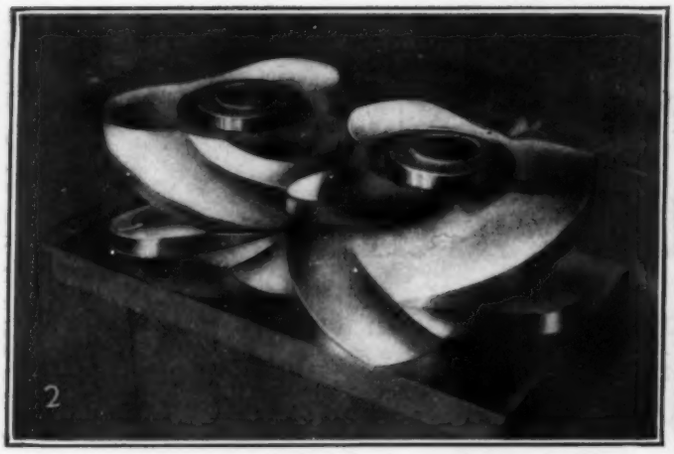


Fig. 2—Bronze rotors on testing fixture.

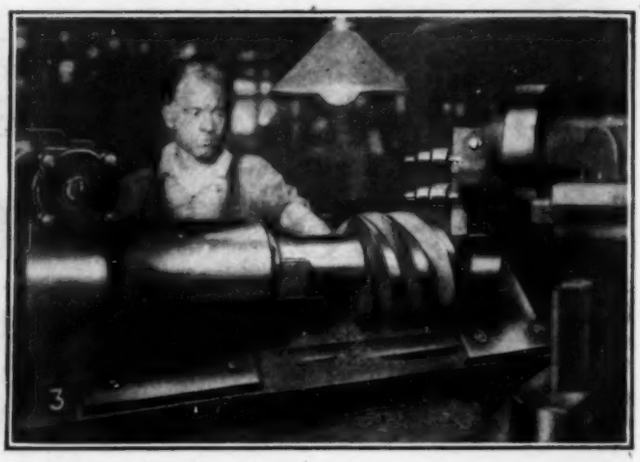


Fig. 3—Planing the teeth in a string of "rights"

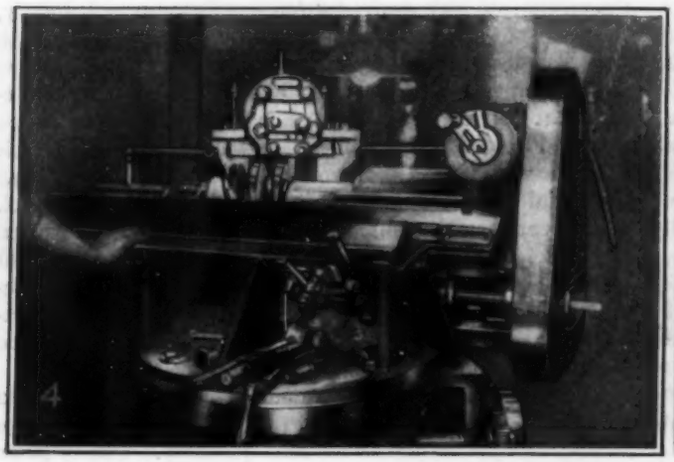


Fig. 4—Fixture on which rotors are mounted to plane the teeth.

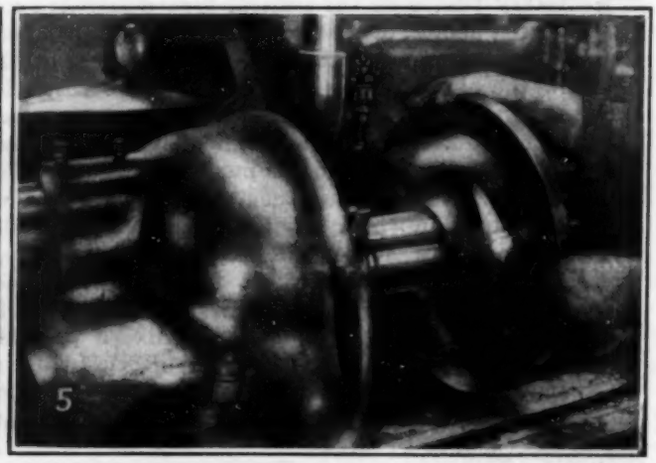


Fig. 5—Grinding the outside diameter

applies only to the finishing tool), and with somewhat more than the usual amount of clearance on the sides.

The stroke of the shaper ram is adjusted to carry the tool clear across the work, and the relative height of its square end (again of the finishing tool only) above the work is such as to pass over the center line of the mandrel at a distance equal to the radius of the worm at the root of the thread. The roughing tools are narrower, and are adjusted to a slightly greater relative height, since the object of the roughing cuts is to remove surplus metal and leave just enough stock to enable the finishing tool to size the work without too great effort, and with a practically balanced cut.

As the tool passes back and forth across the work, the work is rotated slowly and in small increments by means of the ratchet feed, acting through the worm and wormwheel of the fixture. The knee of the shaper is at this time clamped tightly, and no other relative movement of the work and tool takes place.

One corner of the tool cuts downward on the face of the advancing tooth to the left (as seen in Fig. 4) as it enters the work, while the opposite *side* of the tool cuts upward across the receding face of the tooth to the right as the tool passes beyond the center line of the work. The face angle of the teeth is determined by the angular setting of the fixture, and the curved surfaces consist of a series of minutely-stepped straight lines, which are smoothed over with a file. Left-hand parts are made by swivelling the fixture to the opposite angle.

To make a rotor, one right- and one left-hand part are joined on an arbor and are permanently secured by large dowels. The teeth of the assembled part are smoothed by filing, and a pair of rotors is fitted by rolling them together on a fixture similar to that shown in Fig. 1, taking down the high spots with file and scraper.

The outside diameter of the rotors is finished by grinding. They are handled individually, as shown in Fig. 5, on a standard cylindrical grinding machine. A ring gage is used to determine the size, for which a limit of $\frac{+\ 0.000}{-\ 0.001}$ is allowed.

Lapping and honing are terms that cause more or less confusion in automotive shops. It is suggested that lapping should refer to the use of loose abrasive or to laps charged with loose abrasive. Honing is where the abrasive is in the form of a slab or stone.

The number of apprentices a shop should have depends on the kind of work, and particularly on who instructs the boys. The number must be limited if the foreman has to do the teaching and be responsible for production as well.

One well known machine-building shop, having a special instructor, has apprentices numbering up to 13 per cent of the men on direct production work. This ratio is higher than in most shops but works well in the shop referred to.

Manufacturing Tools to Make Safety Razor Blades

By ELLSWORTH SHELDON
New England Editor, American Machinist

A case where toolmaking is a manufacturing job—All parts must be strictly interchangeable—Limit of tolerance is 0.0001 inch—Tools must go together without fitting

A PREVIOUS article under the title "Making Two-and-One-Half Million Blanks Every Day," described the tools and methods employed to produce this immense number of blades in the Boston plant of the Gillette Safety Razor Co. The present article deals with the methods by which the actual cutting tools and other perishable parts are made up in lots of fifty or more and are kept in stock so that the sub-presses with which the blanking operation is performed may be serviced promptly and without delay to production.

The first two sub-presses were made in the toolroom of the E. W. Bliss Co., the designers of the tools and method, by the usual means employed in making tools of a more than ordinary degree of accuracy, but because of the enormous output expected from them, rendering frequent regrinding and replacement of parts necessary, it was apparent that some extraordinary system of upkeep must be evolved in order to make possible the reduction of the maintenance cost to a reasonable figure. Included, therefore, in the design of the tools was the provision for reproduction of dies, punches, strippers and other parts subject to much wear, by means of jigs and fixtures that in effect took the job out of the toolmaking class and made of it a manufacturing proposition. A special department of the Gillette toolroom is detailed for this work alone, and here are to be found at all times several of the sub-presses in process of regrinding or replacement of the tools.

The job of regrinding involves the partial disassembling of the sub-press, the plunger being taken out and the housing removed from the base. The dies remain attached to the plunger, which is inverted on the magnetic chuck of a surface grinding machine. At the same time the punches, which remain with the base of the sub-press, are being ground on an adjoining machine handled by the same operator. The average number of times that the punches and dies can be reground before having to replace them is sixty, and since the average production per grind is 400,000 blanks, about twenty-four million may be

The first article. The second will appear in an early issue.

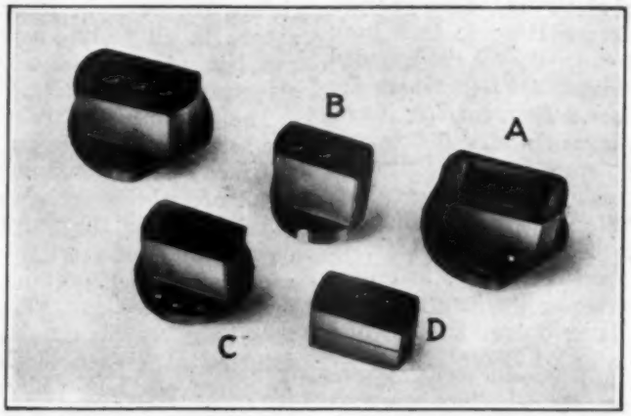


Fig. 1—Separate tools before the final grinding

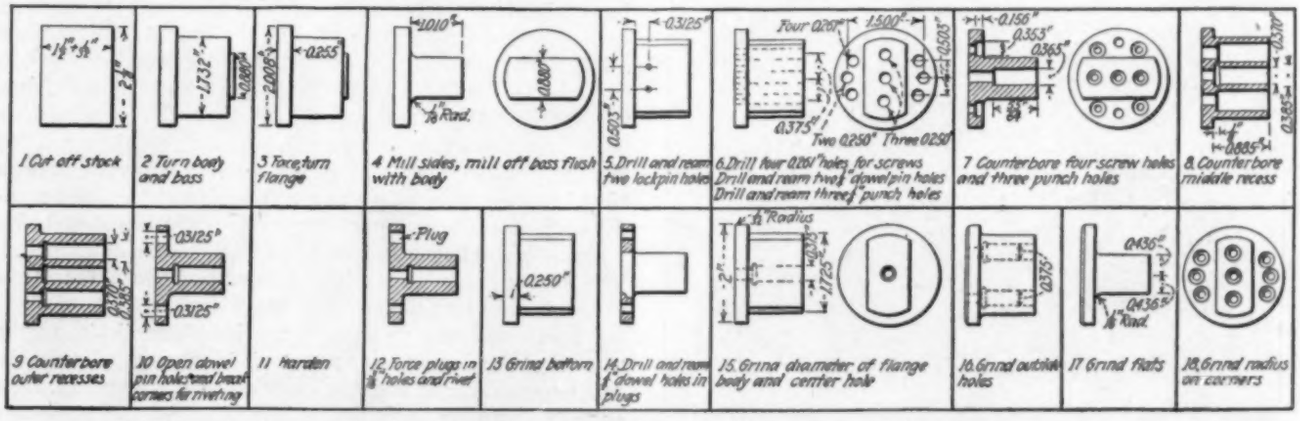

1 Cut off stock
2 Turn body and boss
3 Face, turn flange
4 Mill sides, mill off boss flush with body
5 Drill and ream two lockpin holes
6 Drill four holes for screws. Drill and ream two dowel pin holes. Drill and ream three punch holes
7 Counterbore four screw holes and three punch holes
8 Counterbore middle recess
9 Counterbore outer recesses
10 Open dowel pin holes and bevel brass corners for riveting
11 Harden
12 Force plugs in holes and rivet
13 Grind bottom
14 Drill and ream dowel holes in plugs
15 Grind diameter of flange body and center hole
16 Grind outside holes
17 Grind flats
18 Grind radius on corners

Fig. 2—Sequence of operations in making the punches

expected from one set. As a matter of fact this figure is often exceeded. Completing its quota of twenty-four million or more blanks, the sub-press shows no appreciable signs of deterioration. Having made a few minor adjustments upon it, and with new dies and punches in place, it is ready for a repetition of the performance after a stay of but a few hours in the toolroom.

The record run to date is 1,096,000 blanks at one grinding. While the notes for this article were being made, a sub-press came up from the press room with a run of over 700,000 pieces to its credit—almost double the accepted average.

The principal parts to need replacement are the blanking punches (which are also the piercing dies), the blanking dies, the shedders and the piercing punches. A regular routine of manufacture has been established, operation sheets gotten out, and special jigs and fixtures provided to carry on each operation in making new tools.

In Fig. 1, at *A*, is shown one of the blanking dies. At *B* is a shedder, and at *C* a combined blanking punch and piercing die. At the upper left a shedder is shown within the die, in the position it occupies when in service. At *D* is a plug gage used by the toolmaker in lapping the die to size after it has been hardened. This plug is made like a limit gage, in that one end is 0.001 in. smaller than the other over both dimensions, though it is in no sense a limit gage, since both ends must pass clear through the die. The small end may rather be considered as a pilot to be inserted in the die, and where the larger end does not follow it the die must be lapped.

In making the punch *C*, the blank is cut with a cold saw from a 2⅛-in. round bar of steel. It is then gripped in a four-jawed chuck in a bench lathe to turn back the diameter of the body as measured over the rounded ends of the cutting portion, leaving a flange where the jaws of the chuck grip the piece. Then turning it end for end and gripping it by the newly turned diameter in a special ring-chuck, the flange is reduced to the specified diameter and thickness by turning and facing.

When this method of production was first put in practice it was the intention to leave a small boss, or shoulder, projecting ⅛ in. from the body, and of a diameter equal to the distance across the flats to be left by the milling cutters in a later operation, to which operation it was to serve as a guide to center the cutters. This was found to be unnecessary, however, and the milling cut is now centered without its aid. The second and third stages on the operation sheet, Fig. 2, show this boss.

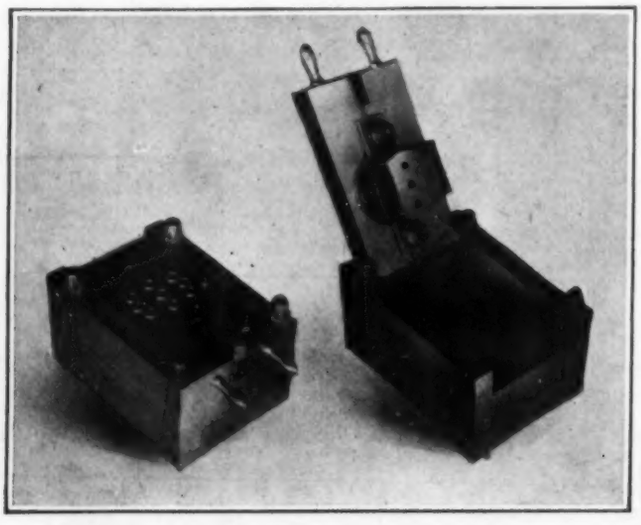


Fig. 3—Jig to drill holes in punches

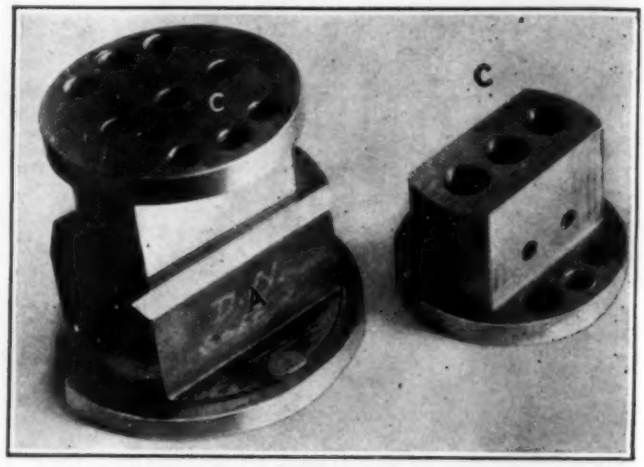


Fig. 4—Unfinished dies and punches

Jigs are provided for the milling operations in which a string of blanks are held by the flanges, and a pair of straddle mills slab off the sides of the punches as shown in stage 4 of the operation sheet.

Jigs are also provided for the drilling operations. The jig shown, open and closed, in Fig. 3, locates all of the eleven holes in the punch at one setting. The punch is held on the underside of the leaf as shown at the right, being located thereon by a shallow counterbore to which the flange of the punch is fitted. Small clamps secure it in place. The box-jig is accurately square in all planes, so that when the leaf is closed and latched, all holes may be drilled without further attention to the setting.

The piercing dies are made as separate bushings and are set into the three counterbored holes to be seen in the face of the blanking punch *C*, in Fig. 4. The two small cross-holes to be seen on the side of the same punch, are for the purpose of receiving key-pins, or dowels, that intersect the holes in which the bushings are seated, and prevent the bushings from turning or being pulled out. The cross-holes, being drilled in the jig before the counterboring operation, go through solid metal. When the larger holes are counterbored, all three of them will intersect the small holes, the middle one intersecting both.

As may be seen in Fig. 3, the three holes that are to receive the die bushings are drilled from the bottom —the flange end—of the punch, the small drill passing all the way through. After the piece has been taken out of the jig these three holes are counterbored from the face of the punch, at which time the counterbore cuts into the cross-holes. Of the six remaining holes located by the cover of the jig, four are for the screws that hold the punch in the sub-press, and two, the middle one of each group of three, are for the dowels by which its final location in the sub-press is determined. The screw holes, to let in the heads of the screws, are counterbored in a subsequent operation.

The three holes to receive the bushings that are the piercing dies, are first opened up by means of an ordinary counterbore, and the punch is then mounted on a special faceplate in a bench lathe, where the holes are bored to size—less grinding allowance—as well as to accurate depth.

The dowel-pin holes, which were drilled to ¼ in. in the jig, are now opened out to ⅜ in. and are countersunk slightly at both ends, after which the punch is hardened. The quenching tank has two parallel horizontal rods running lengthwise just above the surface of the water. These rods are so placed that the flange of an inverted punch will rest upon them while the milled central portion hangs between. The punches are heated in a muffle furnace and quenched by placing them upon these rods with about ½ in. of their length hanging in lukewarm water. This treatment allows the flange to cool slowly, and though it by no means remains soft enough to be worked readily, it is not as hard as it would be if wholly immersed at hardening temperature.

Plugs of soft steel are now driven into the dowel holes in the flange of the punch and are secured therein by upsetting them in the countersinks previously mentioned. The reason for making the holes too large in the first place and then plugging them up is so that they can be relocated after the hardening operation, thus avoiding all chance of error due to a possible distortion in the hardening process.

These dowel holes are the real points of departure in many of the grinding operations which follow in the making of the punch, as well as the means by which the exact location of the punch in the sub-press is determined, and, since the positions of the dowels already in the sub-presses cannot be altered, it is necessary that the holes in the punch flange be located after hardening. To drill new holes in the soft plugs, the punch is held in a jig that locates it from one flat side and one rounded end of the cutting contour.

Making the bushings which are the piercing dies is quite a manufacturing job in itself. Since there are three of them in each punch and three in each shedder, a lot of fifty tools will require 300 bushings. The hole in the center bushing is round, and in the other two it is an oblong with flat sides and rounded ends, very much the same shape as the punch itself, proportionately reduced in size.

Preliminary operations on the bushings are very ordinary. They are made from drill rod on a hand screw machine. A hole as large in diameter as the conditions will permit is drilled in the rod, the body turned to the grinding size and the bushing cut off to length. The next operation is that of broaching the oblong hole.

The device shown in Fig. 5 was built for the job out of whatever material came to hand. Though it is crude in appearance, the work performed by it is one of the most difficult and exacting jobs of the whole sequence. The device consists of a plate to hold the bushing, and a screw-operated crosshead to pull the broach.

Fig. 5—A home-made broaching machine

The original intention was to turn the screw by hand, but the job of pulling six broaches through 300 or more bushings in one lot became too tedious to be tolerated, so a grooved pulley was attached to the handwheel and a small electric motor was mounted beneath the bench to supply power. The crosshead is returned after pulling the broach through, by throwing the round belt off of the pulley and spinning the wheel by hand.

The holes must be smooth and accurately to size over their whole length, since the slightest scratch or imperfection at any point of the inner surface will sooner or later be brought to the cutting edge of the die by repeated grindings and the effective life of the whole set of tools will be materially lessened.

The bushings are hardened for about ⅝ in. of their length. The holes are then lapped with a soft metal lap, charged with a special lapping compound. As the holes of the two outer bushings are not round, the lapping can be done only by a reciprocating motion of the lap. Fortunately there is little trouble experienced from distortion in hardening, and the lapping is required to do little more than to remove the discoloration caused by the heat of the furnace. The center bushings have round holes and are lapped in the usual manner.

Each bushing is slipped over an arbor made to fit the shape of the hole and is ground to size on a cylindrical grinding machine. A limit of error of but 0.0001 in. plus or minus is allowed. The finished bushings go into stock, from whence they are drawn as needed.

Creating Good Will for the Inspector

By Leon J. Lichtenstein

IN PRACTICALLY all industries, the inspector is the natural opponent of the production department. It is he who is always upsetting their schedules by his rejections, however necessary. At best, the production department looks upon him merely as a necessary evil.

But, in a large manufacturing plant which manufactures, repairs and overhauls airplanes, which are most exacting products, he has actually been made the ally of the production department. This has been brought about by having him make a definite recommendation for every part, not passed in the inspection, of a plane for overhaul or repair. This recommendation, while it may be "scrap and replace" is more generally "repair by ——." As the inspector has originally been recruited to inspection duties from the mechanical force, it means that he is offering the engineer for approval a practical, shop-wise recommendation for making repairs. The consequence is that his recommendation is usually approved by the engineer, except in rare instances of policy in which the engineer is better informed, so the production department has a practical detailed recommendation to work to, made from a shopman's viewpoint, rather than an abstract, technical recommendation which would probably result if it were left entirely up to the engineer.

The good will created by this procedure overcomes the antagonism between the production department and the inspector and the production department looks with more tolerance and understanding upon rejections.

THE · FOREMAN'S · ROUND · TABLE

Will Standard T-Slots Help Production?

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

"WHAT'S all this talk about standardized T-slots, Al? Doesn't sound so very important to me. How is it going to help production, anyway?"

"Well, I think it is, Ed, even if it doesn't seem so. In a job shop it might not make much difference. But where you have fixtures that fit on a milling machine table, it's mighty handy to be able to transfer them to other machines at times. As it is, we can't do it without a lot of special tongues or shims."

"But how does that affect a new machine?"

"Just this way: We've got more A & B machines than anything else, so more of our fixtures can be used on them. Consequently, Williams would be much more apt to buy more A & B machines than any others. Any other machine would have to be a lot better in other ways to get a look-in on a new order."

"But will the makers of machines pay any attention to the new standard, Al? Seems to me that there's nothing in it for them in a sales way."

"Depends on the buyers, Ed. I heard Williams say the other day he would insist on them in any new machines he bought. He's going to have our T-slots made over as he gets a chance. It so happens that ours are narrower than the new standard, so he can do it. Then he'll have standard tongues made for all fixtures and we'll be all set for any make of machine that conforms to the standard, planers and grinders as well as milling machines."

"Gosh, that means all around standardization of slots, Al! I'm all for it, then. Let's hope they get busy and standardize other machine tool parts. I don't see why it can't be done."

Do odd-sized T-slots cause difficulties in your shop as they did in Al's?
Did Al over-emphasize their advantages?
What other standards would help?

All foremen are urged to discuss these questions. Acceptable letters will be paid for. The discussion is not limited to foremen, of course

Discussion of Earlier Topics

Taking Care of the Old Men

A FEW evenings ago at a place of amusement I heard someone call "Hello Terry." Looking around I found the speaker to be a member of the orchestra, who when last we met, was a successful machine shop foreman with plenty of enthusiasm.

After the performance we had a chat about old times. I knew that in bygone days this friend was an amateur musician, but why the "come-down" to a bandsman? Well here is his story. Over thirty years inside a machine shop, more than twenty of them as a foreman, and then during a depression in trade, his firm put him on the street at short notice. He then hunted for a job, but no one wants a man over fifty unless there is a war, so his hobby became a profession. This man's story is typical, but few have a stand-by accomplishment of this sort, and something must be wrong when such things are possible. In the machine shops of today level-headed men with brains should be in greater demand than ever before, not excepting the war which only proved their value, and one cannot help wondering whether the casting off of these men as derelicts is not the cause of some of the troubles and difficulties at the present time. Foremen who receive a salary that allows of a surplus to lay by are few and far between. Many are working for a little over the ordinary workman's pay, and in some cases where piecework is in vogue, the foreman is called upon to set up a man's machine and then leave him to draw a larger pay than his own. The sooner we decide that the man past fifty with years of experience is not a derelict, and that all men capable of being foremen are worth paying for, the better for industry.

—F. P. TERRY, *Ireland.*

THERE is always a place within the plant for the old-timer who seems to have outlived his usefulness. Don't forget that the old-timer represents experience. He may be slow, but the newcomer has not the knowledge that the old-timer has. The old-timer, for instance, could play an important part in instructing new help and apprentices, or doing odd bits of the important jobs that require more time and more experience. Often a new man, who has replaced a so-called "has-been," is found wanting when a knotty shop problem comes up. It would have proved "pie" for the older man if he were around to advise.

The old-timer, too, could act sometimes as assistant to the foreman. He would prove a handy addition to the executive force in many shops. By reason of his long experience he could solve problems that would make the department foreman's responsibilities lighter.

Wouldn't this experience prove more valuable in the shop where the man has worked for a long term of years, where it is peculiarly applicable to that shop? Foresighted executives in other plants capitalize the knowledge the veteran possesses; it seems short-sightedness to relinquish the old-timer simply because he has gone back in speed.

—FRANK V. FAULHABER.

I HAVE been the "old man" for quite a number of men, often much older than myself, and am not 40 yet. But I hope the days of Doctor Osler's ideas, which he himself refuted by his long and active life, may be gone forever. I believe most executives have been realizing for a long time that there is room for the different types of men and also for the various periods in a man's life. I think old men can be used to advantage in many shops, if care is taken not to let them interfere where great speed or many new ideas have to be taken into account. It is probably better to have a middle aged man as foreman, as he will do much better with the peculiarities of the older men. Generally it would be better not to segregate the "old boys," but to distribute them through such departments and in such capacities as will be of benefit. The whole question is, in the end: Put yourself in their place and imagine how you would wish to be treated as a self-respecting man who is willing to work, and who will ask no favors. When I remember how one old mechanic, 68 years old, took us apprentice boys under his wing, taught us all the fundamentals of filing, scraping, forging, hardening, and machining, with many good stories out of his long life, never allowing any foul language or filthy stories, I feel compelled to say a good word for the old man.

—H. J. GUSTAV KOPSCH.

MUCH as I admire the big heartedness of Williams and the sincerity of his motives, I would hesitate to endorse them, because the men as a whole could hardly be expected to have the same broad viewpoint. They would tend to look upon it as favoritism, and losing sight of the age of the men, would resent their being released from the drive of high-speed production. They would be tempted to feel that if they slowed up they would be fired, while these men who stood in merely got a new soft berth. Then, too, I doubt if the average shop would have the opportunities for finding these special jobs.

—A. D. KLIGMAN.

THE bugbear that faces most workmen is the time when they are no longer needed around the shop. With the thought before them that they will be let go

THE · NEXT · TOPIC

Arguing With the "Big Boss"

QUESTIONS

Where Ed tells of a railroad repair shop case—

Should the foreman argue with the "Big Boss" as to methods?

Does it pay to plane one piece at a time on a big planer?

when they become old regardless of how long they work for the firm, they become dissatisfied with their jobs and are knockers instead of boosters for the firm.

Williams' plan would work well in the average shop, and the fact that the men know they will be treated right when they become old is going to make them contented. A man who has been a good mechanic all his life is generally proud of the fact, and will not take kindly to a job as a sweeper or watchman. Williams is also going to get the value of years of experience when he puts these men to work on salvage, because their mechanical knowledge will be a great help in determining whether a piece of work can be salvaged or must be scrapped. —THOMAS M. GARY, *Foreman.*

TO PUT a man, who in his younger days was a good mechanic, on such an inferior job as sweeping, would be like telling him that his day was over. The high-production methods of today demand complete concentration on the job in hand, and this is where the old man loses ground. The hustle and bustle makes him nervous and flustered when he finds that he cannot keep pace with his fellow workmen. If kept in the production shop, his general slowing down may cause a lot of trouble. On a job that is line machined and in which the old man has his part, it would give the younger men an excuse for slacking also. What could be more disconcerting to the old man that to know that he is the cause of delayed production? Let us put all the old men in a shop together and let them do such things as brazing, rectification, and odd jobs which cannot be done in the production shop, and see what happens. When the old man has rid himself of the haunting fear that he is of no more use, he settles down with the other old 'uns with an added zest. Good work will still be turned out for the firm, and even if they do no more than earn their wages surely it is better for the firm than pensioning them, and better for the men to be doing something useful. This sort of thing may also be looked upon as a reward for past service, and there can be no question of favoritism, since the chance comes to every one of the workmen who have the interests of the firm at heart. In my opinion, Williams has solved the problem admirably.

—G. E. NEWBERRY, *England.*

AMONG the workmen a pension is likely to be regarded as a sort of parental care, and I believe that the pension plan is not the best generally. An educational plan along the lines of thrift lends itself to the use of a small, as well as a large organization, and I believe is one of the best ways to help men provide for their future needs.

Such a plan can be carried out by the distribution of literature, shop meetings, personal interviews, and help on the part of the employers to care for their employees' savings, make investments, and finance matters that circumstances make necessary to be done on the installment plan.

While we sometimes hear the expression from men, that they are regarded as so many machines, and are disposed of promptly when their usefulness begins to wane, my observations leads me to believe, that employers generally keep their men far beyond the crest of their production period, and usually consider carefully before making any change that could be considered as a letting down process.

However, the time does come in the career of many when their earning power even under the most favorable conditions is reduced. In such instances the man should not feel that he has a claim on his employer for a pension, but should remain in whatever capacity it may be necessary for him to work to be profitable to both the employer and himself. —JOHN MARK MAY.

How Do Mutual Aid Societies Help ?

DEDUCTIONS from my experiences for two years as president of a mutual aid organization may be of interest. First, the benefits should be liberal. We paid $12 a week for the full period of disability for accidents. The same amount was paid for sickness, except for the first week, for which nothing was paid. The benefits were limited to 13 weeks. Accident benefits were paid regardless of whether incurred at work or not; one maximum benefit was for a broken leg, the result of an accident in a football game. It was a professional game and the member was paid for playing. Another allowed claim was from an accident to a member driving a coal team during a temporary lay-off. It might be considered that we had gone far afield in our benefits, but we built up confidence, although some abuse of this liberality was to be expected.

The cost of the benefits was approximately $1 a month, per member, over the two years under observation. This was not raised entirely from dues, some of the receipts were profits from the sale of tobacco and candy to the men. The company, during the two years, donated about $6 per member. Dues were reduced from 50 cents a month to 25 cents. Reserve was increased from $3 to over $10 per member. A good reserve is from 2 to 3 weeks benefit per member. We did not invest the reserve, but kept it as a balance for the checking account. —GEORGE E. HODGES.

THE mutual aid society is an excellent solution of the sickness problem, if most of the men will join it. But, it has been my experience that the men who need it most are the ones who don't join before they need aid. Then, too, their resistance to admitting that they need this aid, unlogical as it is, is a serious obstacle to overcome.

I favor a mutual savings fund as a preferred solution. This gives them an opportunity to save money, which they can draw out in an emergency, and also a borrowing capacity if the need be sufficiently great. It will appeal to many men as a means of saving, at the same time giving them emergency protection. Another solution is to give a reputable insurance representative an opportunity to address the men annually, and canvass them for health insurance. This puts it on a strictly commercial basis, and takes up less of the company's time than a mutual society. —E. L. FAIRALL.

I ASSISTED in the organization of a successful relief association in a good sized factory. The society was formed to do away with the very unsatisfactory collection or donation which was taken up for a fellow workman who had the misfortune to be taken sick. We found that it was not always the hardest working, most deserving man who got the collection, but generally some

fellow who did not try to prepare for the proverbial rainy day, and whose family was therefore in want as soon as his wages stopped. By forming the relief society we at once overcame this condition, and no more collections were allowed to be taken up. It was voluntary with the men to belong or not, and of course only those joining and paying dues participated in the relief.

The company acted as treasurer and deducted the dues from the men's wages, but all other officers were elected by the men, and all benefits were ordered paid by the trustees on presentation of a doctor's certificate to the effect that a member was unable to follow his regular work.

By running the society on a strictly business basis, and having the active co-operation of the company, we were able to get on a sound financial footing, and by having an annual picnic we were able to keep the dues at a nominal sum, and build up a good reserve fund. All in all, we found the relief association a very happy and valuable solution to a perplexing question.

—JAMES MARSHALL.

Which Kind of Man Is More Valuable?

WITHOUT question, the "nosey" man is the more valuable. Naturally, a happy medium between the two would be the most valuable, and probably the so-called "nosey" fellow could be tuned down so that he'll forget petty things. In putting the O.K. on him it is done with the understanding that he does plenty of work. If the fast worker who doesn't seem to give a rap does a good deal more work he may be considered better, because it pays to make a mistake occasionally and get things done, rather than to be so all-fired careful that the day will be worried away over possible mistakes so that there will be no time left to work.

—J. C. P. BODE.

THE man who runs to the foreman would undoubtedly be expensive because he lacks confidence in himself, a condition some foremen enjoy. Yet, a man who considers all conditions in regard to his work is the only man when he possesses confidence along with the skill.

Many foremen are responsible for the first condition, since they make a man use their methods, which may be wrong, rather than allow him to work to his own ideas. Each man should be employed in the capacity in which his ability is best suited. Also if he be a man of initiative and skill those qualities should be used to the advantage of his employer, rather than be destroyed by his foreman through fear of losing his authority.

—JACK HILTON.

I APPRECIATE a man who asks questions if they are of the sensible kind. It often grates on the nerves if I am busy on other things, but I feel if a man is interested enough in his work to notice these things he makes the most thorough mechanic, and does the best job. It gives a confidence in him which repays in the end. When he has finished a job I generally do not have to worry whether it is done right or not, and I do not have to watch his work closely, as it generally will stand inspection.

On the other hand, I do not encourage a man to ask questions that as a mechanic he should know. A man like that is a hindrance instead of an assistance. If you spend your time answering this kind of question you have no time left for other things. I sometimes think it is used as an alibi to get a rest, as the man will stand by idly with his machine stopped until you get a chance to get around to him.

—J. HOWARD STUDHOLME, *Master Mechanic.*

Who Should Do the Discharging?

AS A rule an employee is hired because he is thought to possess qualifications to fill a certain job under a certain foreman. If he fails on that job, do not judge too quickly. It may not be the man, it may be the wrong job or the wrong foreman. Under another man and on a different job, this employee might excel all others.

The employment manager should be able to judge human nature, whereas the duty of a foreman is to produce, and therefore he may be lacking in the study of men. A foreman, when discouraged or in a temper, may judge a man wrongly and discharge him without just cause, whereas the employment manager will check such unfairness. The company has invested a certain amount of money in the employee which it cannot afford to lose, and it is to the advantage of both to find the job for which the man is fitted. He should be placed elsewhere until he does fit.

—A. R. CONE.

Who Should Go to the Storeroom?

THE simplest way to save the time of high priced men now used in trips to the storeroom is to use helpers or messengers for this service. I believe the helper to be the better solution, as you can keep him profitably employed between trips, at the same time holding out to him the incentive of an ultimate mechanic's rating. Where an apprentice is available it should be part of his regular duty to go to the storerooms, for in addition to saving the workmen's time, he can, if he is observant, learn a lot by associating the tools with the job.

—HARRY A. GOSLAR.

Is the Repetitive Operation to be Avoided?

JUST as in advertising, "repetition means reputation," so also in industry repetition means an excellent wage for many a poor chap who couldn't possibly earn a living on his skill and adaptability if thrown on them as his only resources. I have only shifted men from job to job to keep them from getting into what to me seems to be a rut after I have carefully studied their personality, and learned of their previous experiences through first earning their confidence. In this way I have seldom guessed wrong, and my shifts have been generally successful. I don't believe the repetitive workman is often injured at his work, because his work becomes a sort of second nature to him. If something goes wrong, it will be signalled to him by a change in the "song of the machine," that you or I in passing would not notice. So let him dream, for happiness is an unfathomable thing, and perhaps he has captured it.

—DAVID J. RODGER.

Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

A Combined Tap and Drill

BY HERBERT M. DARLING

Some time ago we had to machine a quantity of brass castings like that shown in Fig. 1. The operations included drilling and tapping. The only machine we had on which to do these latter operations, was a two-spindle sensitive drill. To drill and tap the No. 10-32 and the ¼-24 holes meant two operations for each hole. To speed

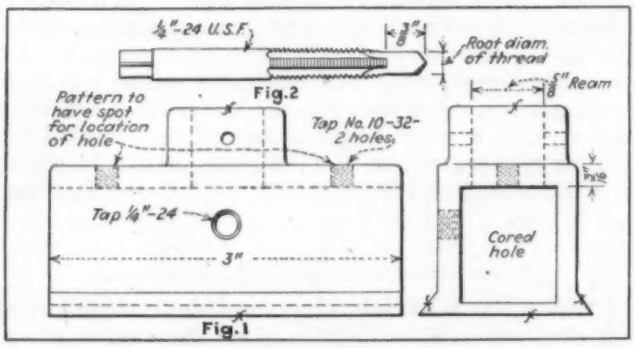


Fig. 1—Castings to be drilled and tapped. Fig. 2—Combined drill and tap

up the work, I ground drill points on the taps, as shown in Fig. 2. The combined drills and taps were used in friction-driven tapping attachments running at 1,050 r.p.m., and a boy was able to turn out 215 pieces (645 holes drilled and tapped) per hour.

Since then we have used similar taps of different sizes on light aluminum castings and they worked very well.

Thread Measuring Attachment for the Micrometer—Discussion

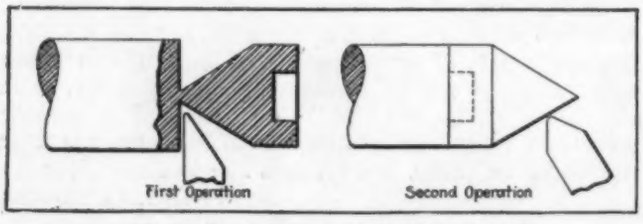
BY ARTHUR SILVESTER

The micrometer attachment described by Joseph E. Abbazia in an article under the title given above, and published on page 877, Vol. 65, of the *American Machinist*, may be inaccurate if made by his method.

It would be hard to tell whether or not the hole and the point were concentric. Even if they were out only 0.001 in., the cone would not bear equally on both sides of the thread.

If I were to make such an attachment, I would finish the hole first and then turn as much of the cone as possible before cutting the anvil from the rod. I would then hold a piece of stock in the chuck and turn the end to a tight fit in the hole in the anvil, being careful to square the shoulder. Using this piece as an arbor, the anvil could be tapped on it and the remaining part of the cone finished. The sketch shows the method.

But why make such devices when thread micrometers that will last a lifetime can be bought reasonably?



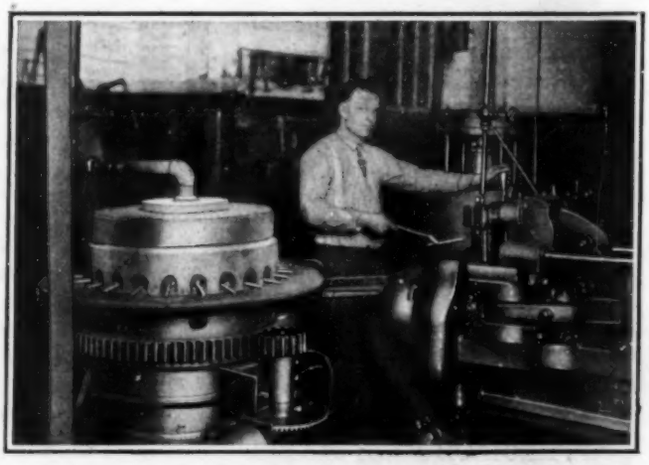
Method of making the attachment

A Rotating Gas Furnace

BY JACK WILLIAMS

The rotating gas furnace here shown is in the forge shop of the Morse Twist Drill & Machine Co., where it is used to heat drill blanks that are to be upset on one end to form the tapered square shanks of "bit-stock" drills.

The burner is in the center, fed with gas and air through the pipe that may be seen at the top, and



A rotating gas furnace

does not rotate. It is arranged to diffuse its heat radially in every direction by means of suitable baffle plates of fire brick. The turret, which includes the hood, apron and large annular gear, is driven through a gear train, the first member of which is provided with a speed regulating device by which the operator can govern the rate of rotation to suit the speed at which he is working.

A blank is placed in each of the radial holes in the

hood, and after the turret has made one complete turn the operator takes out a heated blank and replaces it with a cold one as each hole passes his working position.

After regulating the speed of the turret to correspond with his own working cycle the operator pays no more attention to it; there is always a heated blank in the most convenient position ready for him to pick it up with his tongs.

Changing the Cutting Quality of Abrasive Wheels

BY HENRY SIMON

That different truing devices produce different results in the action of an abrasive wheel is well known. It is less generally realized, however, that the cutting quality of a formed wheel that is already shaped can be varied readily without disturbing its contour.

By holding an oilstone lightly against a wheel while the latter is running, the wheel can be dulled to cut more slowly and to produce a finer finish. By rubbing the contour of a wheel with a piece of a broken wheel while turning it slowly by hand the cutting qualities are improved and the wheel is given a new lease of life. It should be noted that this effect is not obtained so satisfactorily by rubbing in this manner while the wheel is running; the improvement is not nearly so pronounced and the contour of the wheel is more apt to be changed.

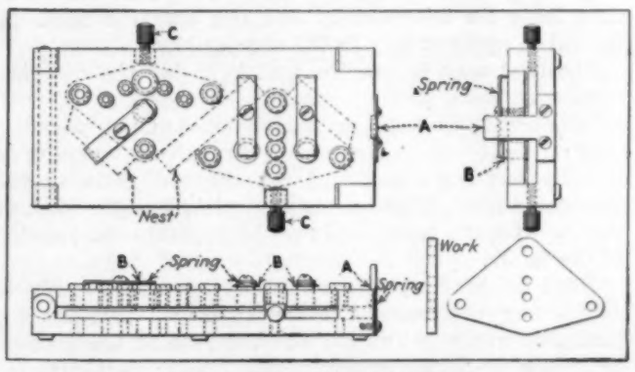
This method of sharpening the wheel while not running is of particular value where it would be difficult or inconvenient to reshape the contour. When grinding a hardened form tool of high-speed steel in a lathe, for instance, the wheel is apt to get dull quickly, especially when the slightly pitted outer layer of stock is being removed from the tool. Frequent reshaping of the wheel would take too much time, but by going over it lightly with the broken piece, it may be brought very nearly to its former efficiency in a few seconds, and without disturbing the set-up.

A Quick-Acting Drill Jig

BY ATOL MAKER

Ordinarily the leaf of a box jig must be locked by means of a swinging screw and a nut, or by some sort of eccentric locking device, the operation of which consumes time.

When operating the jig shown in the sketch, the lid, or leaf, is automatically locked when it is snapped shut and is released again by merely pushing the locking spring *A* away from the leaf with the thumb of one hand while the leaf is raised with the other.



A jig with self-locking leaf

When the leaf is closed, the three brass plungers *B* pass through it and bear upon the pieces to be drilled. A flat spring presses against the tops of each of these plungers, pressing them down upon the work. The spring-actuated plungers serve the double purpose of holding down the work and at the same time tend to push the leaf of the jig upward and against the shoulder on the locking spring *A*.

The pieces drilled in this jig were bakelite end-plates for variable condensers and they were not all alike in size, therefore the knurled screws *C* were used to secure them against side motion while being drilled.

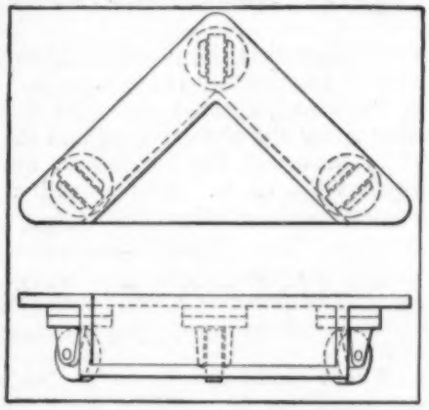
It will be noticed that one end plate is held down by but one plunger while the other end plate is held down by two plungers. This difference is caused by the fact that the positions of the holes are different in one side of the jig than in the other. Where two plungers were used, the springs actuating them were not so heavy as the spring for the single plunger.

Trucks for Moving Machines

BY D. C. WRIGHT

Although the device shown in the sketch is one of the handiest pieces of equipment that I know of for moving machinery, I have never seen it illustrated or described.

The device consists of a triangular, troughed-out piece of heavy sheet steel, mounted on three ball-bearing swivel casters, the under part of the trough section being an inch or less above the floor level. It can be made by cutting and bending pieces of steel to the proper shape and welding them together. Instead of having to pry and "bully" a heavy machine, or case, along the floor on rollers the corners are raised, one at a time, placing one of the trucks under each corner. With the corners, or legs, of the machine resting on the trucks, it is an easy matter to push or drag the entire combination as a unit in any direction. The load is so distributed on the twelve casters as not to be too excessive, and the casters being swiveling, it is possible to definitely "spot" a machine with ease and accuracy, even in cramped quarters.

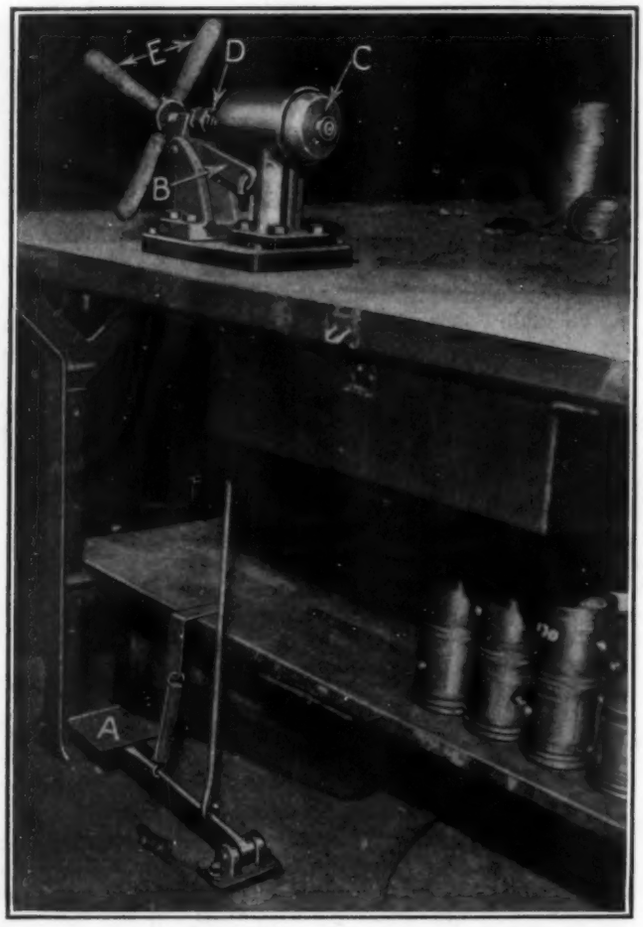


One of the trucks

Holder for Filing Piston Rings

BY HERBERT F. CRAWFORD

Pierce-Arrow practice is to take the sharp corners off piston rings with a small, smooth file. And to make this easy to do, the fixture shown has been found very useful. Pressure on the treadle *A* pulls down the bell-



Holding piston ring for filing

crank *B*, pushes the plunger *C* forward and allows the ring to be slipped into place.

On releasing the treadle the spring *D* clamps the ring under the plunger head and the workman revolves it by means of the handles *E*, while holding the file against the edges. This operation only takes off the corners to a very slight degree.

Set-Up Chart for B. & S. Automatics

By H. C. Lincoln

Where parts are to be duplicated at intervals on automatic screw machines, much time can be saved in setting up if a record is kept of the original set-up and is incorporated in a chart. Such a chart is shown in the illustration. It is made of brass so that it can not be injured by the oil or cutting compound.

Name of Part ..... ○ $\frac{1}{2}$ in. Stop Nut	
Index Turret = 6-32-57-74-80-90	
Feed Stock Dog = 1	Pieces per Hour = 300
Dogs for Spindle Reverse = 62-74	Deflection Dog = 9
Turret from Chuck = $4\frac{1}{8}$"	Stock = $\frac{7}{8}$" Round
Toolpost to Edge of Front Slide = $\frac{15}{16}$"	Toolpost to Edge of Back Slide = $\frac{5}{16}$"
Change Gears	Tools Project from Turret
Gear on Driver = 80	1 Stop = 3"
" 1st Stud = 32	2 Drill = $3\frac{5}{8}$"
" 2nd Stud = 40	3 Counterbore = $3\frac{3}{8}$"
" Worm Shaft = 80	4 Die = $3\frac{1}{4}$"
	5 Knurl = $3\frac{13}{16}$"
	6

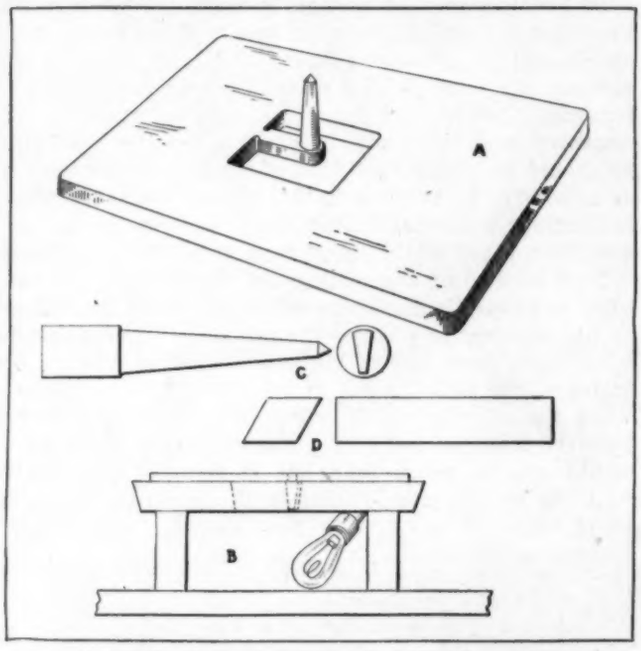
Chart for setting up for duplicate work

A Square, or Clearance Gage

By C. A. Macready

When the clearance amounts to but 0.0015 in. on a die that is $\frac{1}{16}$ in. thick, and when in addition to this small clearance the contour comprises many narrow slots, short radii, and square corners, it is very difficult so to place the ordinary square or clearance gage as to be sure of results. To overcome some of the trouble I designed the tool shown here.

The tool, *A*, consists of a piece of flat ground stock $\frac{1}{4}$ in. thick and of a length and width to suit the work in hand, in which is made a square or rectangular hole of suitable size. Projecting toward the center of the opening from one side of the hole is a narrow tongue,



A handy clearance gage for the die-maker

in the end of which is set a small pin that is ground to the clearance angle desired in the die.

As may be seen in the sketch, the tongue is necked from both sides by filing in a radius about $\frac{1}{32}$ in. deep, so that it is a simple matter to correct the angle of the pin by twisting the tongue if necessary. In this way the gage may be adjusted to angles other than that corresponding to the taper of the pin, but, of course, it then loses its universality and the operator must be careful to apply it only in the one position.

The best way to use the tool is to lay the die face downward on a pair of parallels as shown at *B*, with an electric light bulb so placed between the parallels that its light will be thrown up through the opening in the die and gage but will not shine directly in the operator's eyes. The tool is then placed on the back of the die with the tapered pin projecting into the opening of the latter.

Used in this way it enables the operator readily to detect any discrepancy, however slight, between the clearance angle of the die and the side of the tapered pin when the latter is moved over into contact with the die at any point, for the reason that if the angle of the

die is correct the light will be shut off at the point of contact, while if it is still in error the difference will be shown up by the band of light appearing at one end or other of the pin as the case may be.

If the contour of the die contains sharp corners that would not allow the round pin to approach closely enough to make the desired comparison the pin may be ground to any desired angle as shown in the section at *C*, with the flat sides approaching more or less nearly to an apex, which would give something of the effect of a knife-edge square.

The piece *D* serves a double purpose: to test the angle of the tapered pin before applying it to the die; and to set the filing machine to file the correct clearance angle on the die.

While each pair of opposite sides are parallel in two planes the piece is not square; it is rhomboidal in shape, with its angles corresponding to the desired clearance angle of the die. This angular deviation appears greatly exaggerated in the sketch.

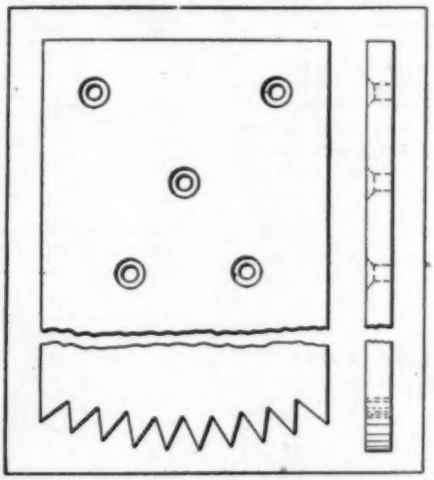
To test the angle of the tapered pin, its application is obvious. To set up the filing machine, the piece is laid upon the table and the table adjusted so that the file touches one of the angular sides evenly. If the file is never allowed to approach nearer than ¼ in. to either end the accuracy of the piece is not impaired by any amount of filing that may inadvertently be done upon it while setting the file.

All four sides of the piece are available for setting purposes, and when all have been roughened by constant reapplication of the file it is a very simple matter to regrind it to its original shape, as the untouched ends provide an accurate seat upon the magnetic chuck.

Safety Devices for Ladders—Discussion

BY DAVID G. KALLSTROM

Reading the article by H. L. Wheeler, under the title given above, published on page 67, Vol. 66, of the *American Machinist*, reminded me of a device I have used for the same purpose. Two pieces of ¼-in. flat steel, rounded and serrated at one end as shown in the illustration, were attached to the inner sides of the uprights of a 10-ft. ladder. This ladder has been in use for five years and has never given any indication of slipping, although the steel pieces were not hardened. They could, of course, be hardened, but if unhardened pieces are used and the serrations should become dull, it would be a simple matter to sharpen them with a saw file. In attaching the pieces to the ladder, care should be taken not to place any two screws in line with the grain of the wood. Otherwise the wood might split.



Anti-slip pieces for a ladder

Practical Shop Problems

Questions of a Practical Nature will be answered in this column

Tolerance on Blanking Dies

Q. Can you decide for us the following contention which arose in our plant? A blank was to be punched having a width of 0.188 *in., plus or minus* 0.002 *in., and this dimension was given on the drawing of the die. The toolmaker contended than he made the die to the maximum dimension on the hole, which now does not give us the required tolerances in the piece. What dimension should have been given to the toolmaker?*

A. The die drawing should have shown the dimension 0.188 in. with the minus tolerance only. The toolmaker should then make the die, working to the minus tolerance, and should have sheared his punch into the hardened die. Any wear of the die in operation, or any expansion of the piece after blanking, would then tend towards the plus tolerance. By having made the die to the maximum tolerance the toolmaker did not allow for any wear.

Chasing Fine Threads on Brass

Q. In chasing a fine thread on a brass shell approximately 2 in. in diameter we are experiencing continual difficulty in obtaining a good clean thread without breaks or chatter marks. We are using a single chasing tool. The thread is ¼ in. long. Can you suggest a better method?

A. The method of chasing with a single tool should work satisfactorily, provided that the tool block is firm under the cut, and that the chasing tool has the proper clearance and not too much rake. You should try the tool without rake or with a slight negative rake.

It is possible that you are using an unsuitable grade of brass for the work. The high brass ordinarily used as a drawing brass may give you this trouble, in which case it is easily corrected by changing to a "leaded" grade having a small percentage of lead. Leaded brass is a standard commercial product, and can be obtained from any brass company.

Black Coloring of Brass—Discussion

BY O. KLEEB

Referring to the question on page 344, Vol. 66, of the *American Machinist*, when just a few brass pieces are to be blackened, the following method can be used:

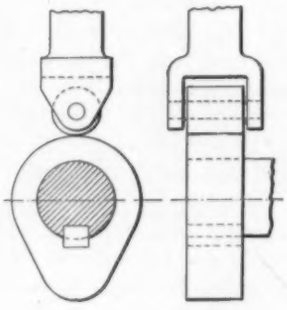
Make a solution of nitric acid and silver. The silver content is determined by experimentation depending on whether you want the article to be jet black or just darkened. Various shades of gray can be obtained by changing the silver content. Heat the article to be colored, then dip it in the solution and heat again until the green deposit disappears. Clean with a dry cloth when cool and apply lacquer.

For articles not subject to friction, this finish will last for years, and is less elaborate and costly than the one described.

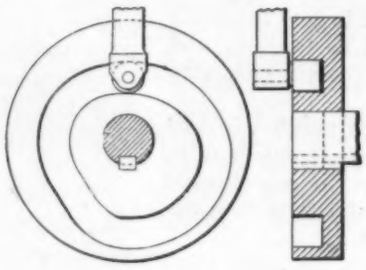
Design of Cams

Typical Forms Used in Machine Design

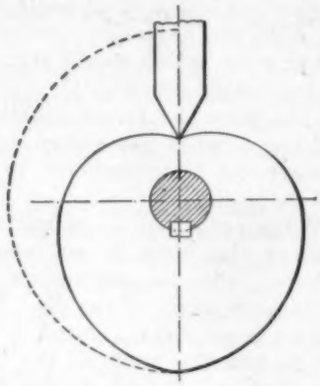
RADIAL TYPES



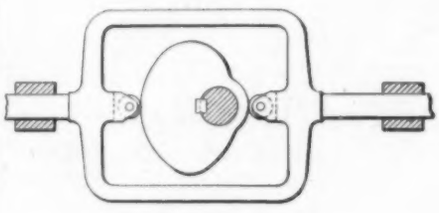
Radial Cam with Roller Follower



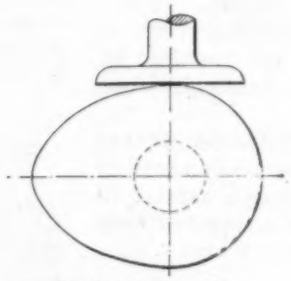
Face Cam



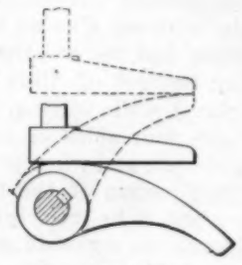
Heart Cam Sliding Contact



Yoke Cam

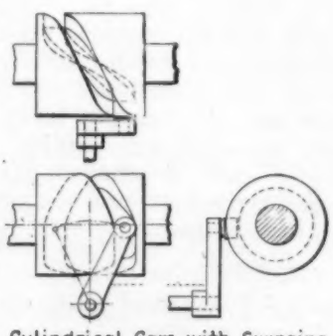


Radial Cam with Mushroom Follower

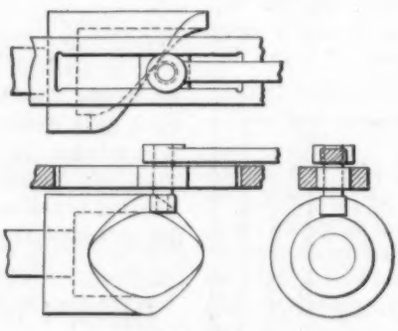


Toe and Wiper

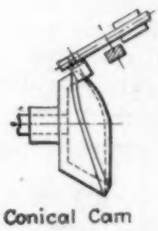
CYLINDRICAL TYPES



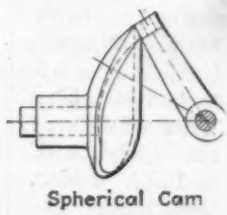
Cylindrical Cam with Swinging Follower



End Cam

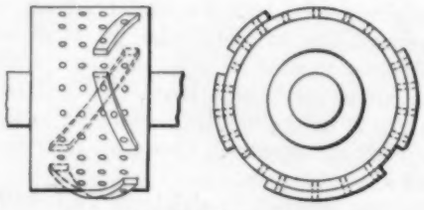


Conical Cam



Spherical Cam

ADJUSTABLE TYPES



Barrel Cam

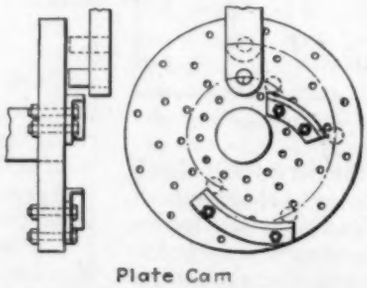
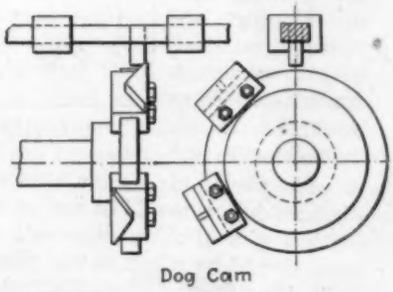


Plate Cam



Dog Cam

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Technical Abstracts

Generation of Cycloid Curves

The cycloidal curve of the impeller lobes used in the Root-type blower is the trace of a point on the periphery of a generating circle that rolls on the pitch circle. It is possible to generate such a curve on a Fellows shaper with a circular cutter, but it is a slow process. A quicker method makes use of a special case of a cycloid curve, that of the hypocycloid the pitch radius of which is equal to the diameter of the generating circle. In this instance, the "curve" becomes a straight line and thus makes a cutting edge that can be easily constructed. The center distance is either the sum or the difference of the pitch radius and the cutter radius.

In practice, where the axial length of the impellers is so great that a shaving chip from the ram action would be likely to tear the metal and spoil the finish, form milling cutters should be developed from templates, generated as described. By using a contour cutter grinder it is easy to transfer the shape from the templates to the cutter. The templates can be formed in gear shapers of the Fellows or Maag type or even on a milling machine by using index centers and a single-blade fly mill whose angle to the axis is adjustable.—Paul M. Mueller, *Mechanical Engineering*, April, 1927.

The Works of Clement Talbot, Ltd.

Production of a new low-priced six-cylinder chassis has been started in this plant. All casting sand forgings are bought out. The work progresses from one end of the block of buildings to the other.

Among the more modern machines are a large vertical high-power surface grinder for dealing with the joint faces of cylinder blocks and heads, and a Kellenberger internal grinder for cylinder bores.

The method of carrying out the first three operations on the aluminum gear box on a Herbert No. 8 vertical miller is typical. A fixture is made to accommodate the component in three positions. The joint facing at the end is milled first. Locating from this face, the component is next transferred to the second station on the fixture for milling the cover faces, after which the third face is milled on the remaining station of the fixture. The three operations take place simultaneously at one pass of the cutter.

In the cylinder section it is the intention to eliminate milling entirely, for the preliminary operations of finishing the top and bottom faces, by carrying these out on a surface grinder. Milling two inclined faces on the engine feet is accomplished by means of a simple swivelling base fixture which may be located in one of two positions by means of a plunger. The operation is performed on a duplex miller but each cut is taken separately. The machining of the cylinder bores is done on a six-spindle boring machine with a special fixture. A heavy trunnion fixture which provides for drilling in six directions is employed for all the holes in the sides and ends of the block.

Another multi-spindle head is used on an Alexander machine, which was previously used for cylinder boring, for machining the valve recesses which are straight sided with semi-circular ends.

For the early operations of drilling, boring, and facing the large and small ends of connecting rods a gang of drilling machines is utilized, being operated by boy labor. A continuous milling fixture is then employed for sawing off caps. This fixture accommodates twelve rods.

Mainly orthodox methods are adopted for machining crankshafts, the pins and journals being turned from a solid billet. The center pair of pins are turned simultaneously, the remainder being turned singly. Special tools are required for producing the large chamfer on the outside of the end webs and for drilling the oil holes. For the latter operation the drills are fed by hand to avoid undue breakage owing to the depth of the drilling and to the fact that the holes break through at an angle.

The spring pads on the front axle are machined on a double head travelling shaper. For drilling the five holes in the spring pad a special multi-spindle head and fixture are employed. For drilling and reaming the pivot bosses a Barnes chuck is used for changing the tools. The remaining operations consist in spot facing the bolt bosses on the under side. This is done without the aid of any special equipment, the facing tool being piloted in the previously drilled holes.

There are other unusual methods, but the general aim is to make the best use of the plant available by the addition of special equipment, rather than to purchase new plant.—*The Automobile Engineer* (England), March, 1927.

C. & O. Profits from Simpler Stocks

The aim of simplification work on the Chesapeake & Ohio Rwy. Co. has been one of progressively eliminating from the stock carried, all obsolete, inactive and unnecessary material.

The effect with which this work has been conducted is indicated by the fact that 6,581 items were eliminated from stock in 1926, among which were 469 sizes of bolts, nuts and rivets; 227 sizes of springs, ferrules, tubing and brass bars; 251 sizes of boiler, firebox and tank steel; 183 sizes of steel bars and shapes; 760 patterns for brass castings; 122 lubricator parts; 169 coach trimmings; 2,076 iron and steel castings; 1,289 car parts, 149 items of lumber; 179 items of stationery; and 707 miscellaneous items.

In the six years of supply improvement, the varieties of material carried have been reduced by 22,000 items.—*Railway Age*, March 19, 1927.

Methods of Storing and Handling Oil and Grease Lubricants

There are three main reasons for providing special equipment for the storage of lubricating oils—namely, prevention of loss and waste, fire hazard, and provision for measuring as issued on requisition. Although fire hazard and loss from seepage are not so great now, with the use of steel instead of wood containers, nevertheless, these two factors alone are of sufficient importance to make the cost of special storage and measuring equipment a good investment. Lubricating oil in containers offers little fire hazard in itself, because it gives off practically no volatile or inflammable vapors until it is heated to or above its flash point.

Comparatively few plant executives have any real appreciation of the amount of loss through leakage. The amount of oil from even a faucet that is dripping slowly, either because of a leak or because it has not been shut off completely, will be considerable in a comparatively short time. For example, a leak of only one drop per second, would amount to 1½ gal. in 24 hr. Many plants have a carefully worked out requisition system for practically all other materials issued from stock, but for some reason, have not placed the oil under anywhere near as careful checking system. Tank storage with pumps save considerable time because the lubricants can be drawn from the tanks more quickly than if it is necessary to wait for them to flow, particularly in cold weather. These tanks or containers are usually placed in multiple, or in batteries of a number of compartments of the most advantageous sizes to store the different materials handled.

Grease lubricants offer a somewhat different handling problem than do the more liquid oil lubricants. One of the most important things to consider in connection with the storage of grease lubricants is to see that the covers are kept closed on the containers so that grit and dust will not get into the lubricant and make it unfit for its intended purpose. Grease should be handled on requisition from the same stores and by the same routine used when issuing oils.—Frank E. Gooding, *Industrial Engineer*, March, 1927.

American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

Taking Their Own Medicine

SOME, at least, of the machine tool builders are taking their own medicine, and finding it very beneficial. For years they have been preaching the advantages of replacing obsolete and worn out equipment with modern machines but not all of them could point to their own shops as outstanding examples of the success of this policy.

An indication of the new trend is given by a letter sent to the "American Machinist" just recently. The letter lists seventeen tools, all with individual motor drive, that have been purchased within the last thirty days by a progressive tool builder in the Middle-West. An Eastern manufacturer of tools spent considerably more than a quarter of a million dollars last year in replacing production equipment in his shop.

The two companies in question are making money. Perhaps their progressive ideas on equipment policy are largely responsible. If so, the inference is clear that it will pay some of the ones who failed to make money last year to follow suit. At the same time their success should prove to equipment buyers that a tool which pays for itself in a year or less is a gilt-edged investment.

The Succession to the Throne

THERE is one thing in connection with the monarchy as a form of government that should commend itself to the head of any business—that arrangements are always made for a successor in case anything happens to the ruling monarch. Perhaps it would not be altogether wise to have a crown price for every business as the favored individual might be inclined to lean somewhat heavily upon his laurels.

The point is that far too many industrial leaders have given too little attention to their successors. Most of them are naturally men of unusual vigor and they ignore the inevitable fact that they must slow down or take the consequences. If you question the accuracy of this statement just stop and count up how many successful business men of your acquaintance have suddenly dropped dead between the ages of forty-five and fifty-five. They could not realize that details, and even plans, should be assigned to assistants, and they paid the penalty.

The wisely run business enterprise will make sure that good men are coming along to take the places of the present heads and it will not wait too long to give the younger men their chance. It is far better to make it possible for these younger, more ambitious men to become financially independent at an early stage so that they can put all their imagination and thought into promoting the business instead of how to make ends meet in their family budgets, than it is to keep them back until the older men break under the load.

There is also this to be considered. The older man is more apt to be satisfied with things as they are. He is conservative, because he can't force himself to a prolonged struggle to put a new idea across, whether he realizes the reason or not. Keep the older heads for advice and guidance but let the younger ones that are willing to take a chance push things through.

Economic Limitations

ONE of the most interesting developments in the distribution field is the farmers' co-operative organization. A number of these societies are functioning and they are becoming more successful as they discover the limits within which they can operate successfully.

Some of the earlier ones came to grief because they undertook to eliminate the whole distribution machine that had been built up over a long period. Experience proved that while some of the middlemen could be dispensed with, others were performing a service more economically than it could be done by the co-operative body. The latter group, in the long run, must continue to function because they are giving a real service and the co-operatives will achieve the maximum success by working with them.

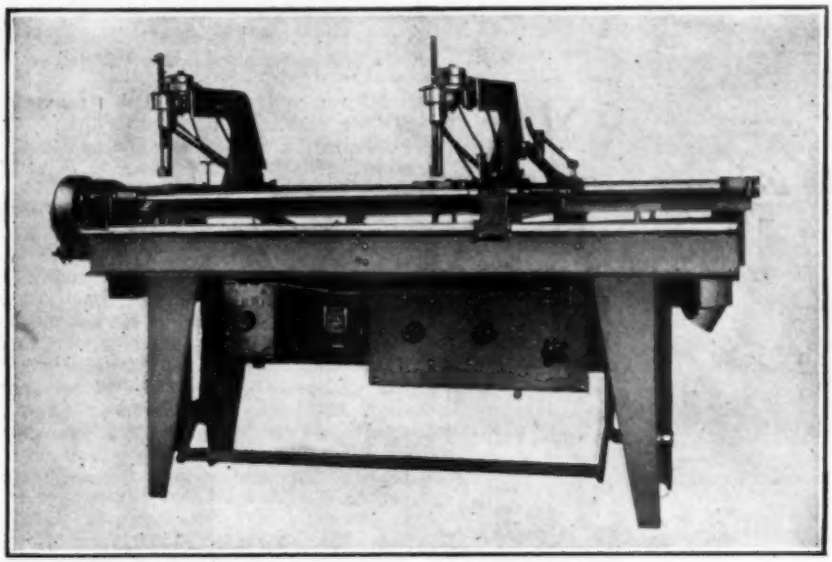
The same reasoning applies to the distribution of metal working equipment. Some manufacturers are convinced that they can take care of distribution to better advantage by direct selling than they can through a dealer's organization. Generalities are dangerous here because of difference in product and in organizations but it seems to be safe to say that so long as the dealer can function more economically as a distributor than the manufacturer can he will continue in the picture. If he cannot he must fade out.

One of the major factors in the case is the amount of fluctuation in the business curve. If the wide swings of the past are to continue, the group that can weather the slumps with the least loss will be the continuing one. If, on the other hand, business remains practically stable, this point is less important. In the past, the dealer organization has in general been better able to keep going in dull times by reason of the greater diversity of its merchandise. Whether this will always be the case remains to be seen.

Shop Equipment News

Lincoln Carbon-Arc Butt Welding Machine

THE carbon-arc butt welding machine shown is a recent development of the Lincoln Electric Co., Cleveland, Ohio. The use of the electric arc as a source of welding heat is an innovation in butt welding, which has usually been carried on with a resistance type of welder. It is claimed that this arc butt welder can be applied to certain classes of butt welding problems that cannot be handled on a resistance welder. For instance, a plug may be welded into the end of a tube, or a round bar of small diameter may be welded to one of a larger diameter. With the arc butt welder the heat is applied to the joint by the carbon arc and the bars are revolved to distribute the heat uniformly. End pressure is applied to squeeze out the slag and complete fusion.



Lincoln Carbon-Arc Butt Welding Machine

The pieces are held in several ways, depending upon the nature of the problem. In the case of welding a plug-shaped piece into a tube, the pieces are held with spring chucks. Where necessary, supports are provided between the spring chucks. Through these chucks, heavy pressure is applied to the weld so as to squeeze out the slag and gas pockets, while the weld is kept at high temperature as the piece is revolved.

The machine illustrated is designed to weld one tube section to another or one tube section to a solid section. The maximum diameter of tube that can be handled on this machine is 8 in., and the maximum length of piece 60 in. Tube wall thicknesses up to $\frac{3}{4}$ in. may be welded, and at this maximum capacity the welding rate is 40 ft. per hour. Power is supplied to the arc through a motor-generator set of 40 to 60 volts. The power input is about 23 kw. to each of the two welding heads. The motor is a standard induction motor and does not take a special power rating.

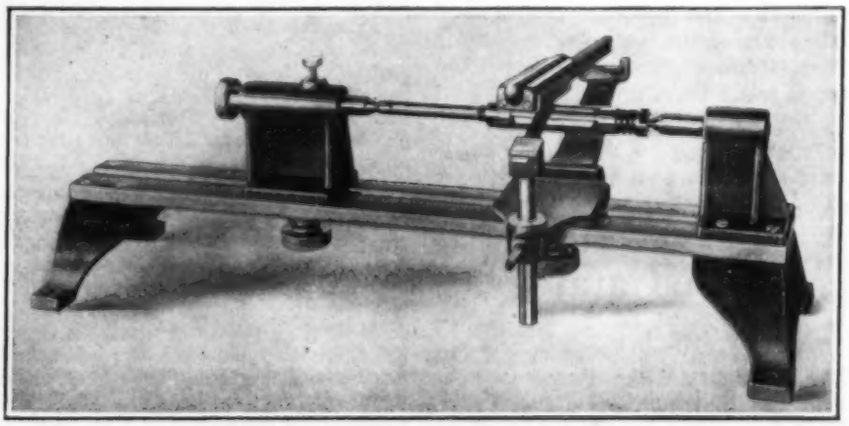
The entire machine is built of welded steel, and no gray-iron castings are used in its construction. It is claimed that the equipment is practically unbreakable and that the cost is lower than would be expected for a newly-developed machine, due to the use of welded steel construction in place of castings. The machine occupies a floor space of 4x10 ft., and 6 ft. of head room.

Foster-Johnson Reamer Sharpener

The Foster-Johnson Reamer Co., Elkhart, Ind., is marketing the hand reamer sharpener shown in the accompanying illustration. It will handle all straight-bladed reamers, having centers in the ends, that are not over 16 in. in length nor over 5 in. in diameter.

The unit consists of a bed having a fixed headstock and an adjustable tailstock. The tailstock center is backed by a spring, and the amount of pressure developed can be regulated by the means of a knob. When the reamer is set up in the machine, it is prevented from rotating by a spring blade that engages one of the reamer blades and thus furnishes a means of indexing.

The reamer blade is sharpened by means of a hone, the handle of which rests on an adjustable support. In this way the stone can be made to conform to the angle of the blade.

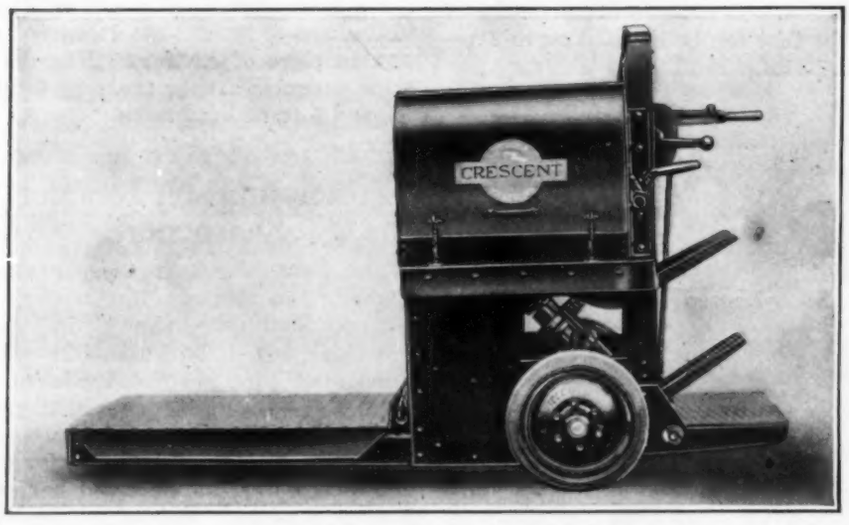


Foster-Johnson Reamer Sharpener

Shop Equipment News

Crescent "Star" Electric Truck

The Crescent Truck Co., Lebanon, Pa., has developed a small, low-priced electric truck for use in congested plants with narrow passage ways. It has an overall width of 30 in. and will run through a 32-in. doorway. It can also be used on a small elevator where a heavy truck would be out of the question. The truck was developed for use with 7-in. hand lift truck skids, and it has a capacity of approximately 3,500 lb. Its weight with a 9-plate battery is approximately 1,525 lb., and its over-all length 82 inches.



Crescent "Star" Electric Truck

The drive of the truck is by a 24-volt d.c. motor through a worm and wormwheel reduction unit. The driving wheels are 15x3½ in., and have pressed-on automotive-type tires while the trailing wheels are 6x3 in. of steel. The unloaded speed is 6 miles per hour, and the loaded is from 4 to 5 miles per hour. The truck has a turning radius of 7½ ft. The patented lifting mechanism has a special foot action and it is claimed that a man weighing 135 lb. can lift approximately 3,500 pounds.

Trade Catalogs

Air Cleaners. W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa., has published Bulletin No. 227 in which is described various devices for removing moisture, oil and dirt from compressed air. Control valves are also listed. The leaflet consists of four pages and is well illustrated throughout.

Band Saws. The Henry G. Thompson & Son Co., New Haven, Conn., has recently published a leaflet entitled "Band Saw Efficiency." A table of recommended speeds and number of teeth for cutting various materials is given. The method of adjusting guides is also completely described.

Bearing Metal. The Magnolia Metal Co., 75 West St., New York, N. Y., has published a revised edition of its bearing metal handbook. This publication contains ninety-six 4½x6-in. pages of practical data, suggestions and instructions on the selection and preparation of bearing metal for various kinds of service. The book is illustrated with several sketches showing improved methods of arranging shells for babbitting, proper proportions and clearances of bearings and various arrangements of oil grooves. The publication is indexed.

Cranes and Hoists. The New Jersey Foundry & Machine Co., Division of Henry B. Newhall Corp., Garwood, N. J., has published a large illustrated leaflet describing cranes and hoisting equipment for use in handling a wide variety of materials in diversified plants. The presentation is largely pictorial and shows actual installations of the apparatus.

Flexible Shaft Equipment. The Stow Manufacturing Co., Inc., Binghamton, N. Y., has issued bulletin G-2 on its flexible shaft equipment. The combination tool for drilling, buffing, polishing, grinding and brushing is first described, then the Stow portable emery grinder with rope drive, the belt-driven flexible radial grinder and other equipment are taken up in turn. The leaflet contains six pages and is illustrated.

Lighting, Airport and Airway. The Westinghouse Lamp Co., 150 Broadway, New York, N. Y., has published its lighting bulletin E-107 entitled "Airport and Airway Lighting." This publication contains forty 6x9-in. pages and is profusely illustrated throughout, largely by halftones. The development of aviation lighting is first traced here and abroad followed by a brief resumé of the progress made in air transportation in this country. Airport lighting is discussed under five heads: Rotating beacons, boundary marking and obstacle lights, landing-field flood lights, hangar lights and auxiliary lights. Suggested layouts are given and numerous illustrations are used to show actual installations. Lighting of the airplanes themselves is also discussed. A complete list is also given of Mazda Lamps for aviation use together with a table of recommended illumination intensities.

Milling Machines. The Ingersoll Milling Machine Co., Rockford, Ill., has published a large illustrated leaflet showing various classes of work done on milling machines in its own shops. The leaflet is profusely illustrated with photographs.

Motors, Electric. The Master Electric Co., Linden and Master Aves., Dayton, Ohio, has issued a leaflet on its motors entitled "Performance that Bears the Spotlight of Investigation." The reliability of these motors and their ability to operate under adverse conditions are brought out. Numerous applications of the motor are illustrated. The subject is attractively presented.

Nickel Steel. The International Nickel Co., Inc., 67 Wall Street, New York, N. Y., has released a booklet entitled "100 Years of Steel Improvement." It contains historical data on the development of nickel steel that will be used as the basis of an advertising campaign during the coming year. The publication is well illustrated and attractively arranged.

Pamphlets Received

Advertising Manager. The Policyholders' Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York, has published the fifth booklet of its series on business organization entitled "The Functions of the Advertising Manager." The first part of the bulletin is devoted to a discussion of the duties and responsibilities of this executive. Simple forms of budget records are also shown. In the second half of the report the organization of the advertising department is discussed and charts are used to show graphically the make-up of such departments in three large, well-known companies. The publication contains twenty-four 5½x7½-in. pages

NEWS OF THE WEEK

Prompt Service and Simplified Procedure Now Assured in Patent Office

New regulations praised by lawyers

THE benefits conferred upon the public by the last session of Congress in the passing of legislation for the improvement of our patent laws are enumerated in a statement issued by G. Willard Rich, of New York, a member of the Committee on Patent Law Revision of the American Bar Association. Changes which will lessen the time required in obtaining the grant of patents, and a simplification of the procedure in the Patent Office, and the courts, with a corresponding decrease in expense to the inventor, have been advocated by some of the leaders in the patent profession for a number of years. The present changes in the law were indorsed by the American Bar Association.

Referring to the different bills passed, Mr. Rich paid great tribute to the excellent work of Thomas E. Robertson, Commissioner of Patents, and the corps of patent office examiners, in accomplishing an almost overwhelming task in bringing the work of their office nearly back to normal within the two years following the war.

One of the most important advances made by the new law is the requirement that amendments must be filed by the inventor within six months following an action by an examiner. For a number of years past the inventor could allow his case to lie dormant for a year at a time. The cutting of this period in half will result in a great benefit to society in that the manufacturers will be informed of the trend of inventions in their respective lines with reasonable promptness.

The Selden Case

The history of the development of many of the industries of this country is replete with harrowing experiences of expensive litigation forced upon manufacturers by the grant of a controlling patent which the owner withheld from issue until his competitor had gone too far with his investment in plant and equipment to withdraw until the aid of the courts had been invoked.

Mr. Rich referred to the Selden patent, for motor vehicles, as probably the best known example of this sort of an attempt to lay tribute upon an important industry affecting thousands of people.

The work in the Patent Office will be rendered vastly more efficient under the new laws by an increase in the number of members of the Board of Appeals. In addition to this, one of the appeals formerly allowed to the commissioner in person has been abolished, and the right given to the inventor to carry his case from the Board of Appeals direct to the Federal Courts.

A stride has been made in the interference practice in that, in addition to eliminating one appeal in the Patent Office, the final appeal carries the interference into the Federal Courts, where the case may be presented on the same printed record that was used in the Patent Office, supplemented by further evidence which may be taken before the court if such is desired.

Hereafter parties interested will be benefited by the knowledge obtained from the marking of patented articles with the number of the patent, instead of the date, as has been the previous custom. This will enable anyone to locate a patent in the Official Gazette quickly and accurately. It is expected that the new laws will facilitate the granting of patents and thus materially shorten the time in which improved manufactured articles are brought into the commercial markets.

N.M.T.B.A. Adds Annex to Exposition

The National Machine Tool Builders' Association has completed arrangements for a "Canopy Arcade" which will accommodate thirty additional exhibitors in the National Machine Tool Builders' Exposition to be held in Cleveland, Sept. 19 to 23.

According to the association's announcement it happens, fortunately, that directly opposite the entrance to the West Annex of the auditorium there is a fairly wide, paved street which formerly cut through the site of the auditorium. This unused street comes conveniently to a dead end so that, if properly enclosed, it is transformable into an arcade leading toward the registration entrance of the West Annex itself.

Arrangements for the use of this area have been completed. Power and other exhibit service provisions will be brought into the arcade which will provide effective area for operating machinery displays.

The association has begun the assignment of booths within the new arcade area to a waiting-list of companies which have indicated exact and definite requirements. A complete list of exhibitors will soon be ready for announcement.

The exposition office of the association has moved to 225 West 34th St., New York, where larger quarters are available. Detailed preparations for and management of the exposition are centered in this office, under the direction of an association committee comprising J. Wallace Carrel, chairman, the Lodge & Shipley Machine Tool Co.; P. E. Bliss, the Warner & Swasey Co.; H. W. Dunbar, the Norton Co.; O. B. Iles, the International Machine Tool Co.; and E. J. Kearney, the Kearney & Trecker Corporation.

Canada to Have Steel and Power Show

To bring under one roof the best modern equipment for industry, and to enable executives and workers to hear vital subjects discussed, is the primary object of Canada's first steel and power show to be held in the new Varsity Arena, Toronto, on Aug. 31 and Sept. 1 and 2. Sponsored by many Canadian organizations, the exposition is backed by such well-known societies as the Montreal and Toronto chapters of the American Society for Steel Treating; Canada Council, Toronto Council and Hamilton Council of the Universal Craftsmen's Council of Engineers; Toronto, Hamilton and the Dominion engineering bodies.

In the exhibits, many of which will be in operation, will be featured the use of metal working, heat-treating, materials handling, welding, power generating, refrigerating, ventilating, and electrical equipment. High speed, carbon and alloy steels, bearings, refractory and heat insulating materials, packing, water treatments, fuel and lubricating oils will also be displayed.

During the three days, technical sessions will be held at which papers will be delivered by recognized authorities.

International Economic Conference in May

The International Economic Conference is to be held at Geneva, May 4. Names of the American delegates appointed by the President are:

Henry M. Robinson, of Los Angeles, who served on the Dawes Commission;

Norman H. Davis, of New York, Assistant Secretary of the Treasury and Assistant Secretary of State in the Wilson Administration;

John W. O'Leary, of Chicago, president of the Chamber of Commerce of the United States;

Alonzo E. Taylor, of Stanford University, who was associated with Herbert Hoover during the war and is especially familiar with agricultural problems;

Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce and an authority on international economic questions.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

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ALANSON B. HOUGHTON, our Ambassador to Great Britain, recently made a speech at Plymouth to celebrate the sailing of the "Mayflower" from that English port to America. Mr. Houghton's address was chiefly devoted to a glorification of this country's prosperity. He said that there was nothing artificial or ephemeral about it and that any setback that might occur in the future would be as superficial and fugitive as shadows on a wall, for, he concluded, no economic society ever was more solid in foundation and structure than is the United States of today.

The ambassador's remarks are quoted because they probably express the prevailing view in most of the financial centers of the United States. There are but few who entertain any doubts of the future and even those who suggest the possibility of a temporary reaction are indulgently regarded as chronic pessimists.

It must be admitted that there is much to warrant the prevailing optimism. Dividends paid on April first by five hundred important corporations exceeded $500,000,000. Postal receipts show a substantial advance over last year. The revenues of the Western Union Telegraph Co. in 1926 were the largest in its history. The International Harvester Co., whose business is supposed to reflect the condition of the farmers, earned nearly $23,000,000 last year, and the General Electric Co.'s sales during the year were the largest on record.

The bank clearings for the week ending March 24 were 7½ per cent above last year. Freight cars loaded during the week ending March 19 increased 29,843 over the same week last year, and although 23,347 cars of this increase were coal cars, merchandise traffic other than coal was again running ahead of the record of a year ago. The trans-Atlantic steamship companies are cheerful in the expectation that more than 300,000 American tourists will visit Europe during the coming summer and the National Industrial Conference Board estimates our national wealth in 1925 at $355,300,000,000 as against $320,800,000,000 in 1922. Ours is indeed a "billion dollar" country, and with such figures before them and an apparently endless supply of bank credit, it is not surprising that most of the people who have access to the stock market should still be asking what to buy.

That the end of the upward movement will come sometime and when it is least expected is as certain as that the sun will set even though it is to rise again. But in so far as stock exchange speculation is concerned the night still seems to be some time away. It is. however, undeniable that many securities are selling at prices which presuppose that the present era will last indefinitely, and those who believe that prudence is the better part of valor will not forget that past experience shows that it is wise to sell when the selling is good. It is true that no indication of dearer or less abundant credit can be perceived, but easy money does not take the place of profits when it comes to paying dividends and stocks will be less eagerly bought when profits become more difficult to earn. In fact, there are broad backwaters even while the main current still runs strongly. While many of the leading stocks made new highs last week on one day no less than 53 issues sold at new lows.

In distributive trade and commerce, as distinguished from finance, the facts as usual are less consistent. The Federal Reserve Board's combined index of sales of six leading lines of business for February indicates that the volume of wholesale trade was the lowest reached in any February since 1922, but retail trade with the exception of the mail order business and one other seems to be good.

In the grain markets the trend has been a declining one; but cotton has shown great underlying strength on the continuation of the export demand despite the ominous news that has come from China. Sugar has shown a little more steadiness now that the Cuban mills are commencing to shut down. But coffee has continued to sag as a bumper crop looms in sight and Brazil's control of exports is threatened.

Railroad earnings have ceased to show the uniformity of increase reported last year but the "coalers" have been prosperous and the net operating income of 71 roads for February was 12 per cent more than a year ago.

In the face of the universally deplored accident to Henry Ford a little less is heard of the rivalry in the automobile industry. The latest figures available indicate that the total demand for new cars is still somewhat under last year even though a numerical majority of the producers report gains.

The country faces the much discussed coal strike with complacency. Everybody is prepared for it and the feeling is that the supply of non-union coal will be sufficient for the country's requirements, at least until the strike ends, as it must, sooner or later.

For the present at least America's prosperity seems sufficient to enable her to withstand almost any shock and if a change occurs here it will probably come from within rather than from without.

WHAT'S DOING IN INDUSTRY

THE FIRST week of April disclosed no large amount of purchasing by users of machinery and machine tools. In more than one important industrial center there was a noticeable improvement in the general tone of business, but orders for the most part were confined to single machines. Special high-production equiment leads in the present demand.

DETROIT reports a marked improvement in sales, with the automotive outlook better than it was last month. In Cincinnati, orders are fewer but inquiries promise an early return to normal volume. The demand is spotty in Indianapolis, but steel plants are active in seeking quotations.

NEW ENGLAND manufacturers note a general improvement, reflecting better conditions in the automotive and the aircraft building industries. A steady volume of hand-to-mouth buying makes the New York market somewhat optimistic over the prospects for the coming weeks. Steel mills and automobile building are fostering a decided improvement in Canada. The South reports a slow but steady increase in sales, with general industry active.

FOR THE PRESENT at least America's prosperity seems sufficient to enable her to withstand almost any shock, and if a change occurs here it will probably come from within, rather than from without.

The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

CHICAGO

While business in machine tools for March has, in the main, shown some increase over the two preceding months, it has not quite met the expectations which had generally been expressed earlier in the year, and which were based on forecasts of a larger production by industrialists. Railroad demand has been somewhat disappointing to a number of concerns which had looked forward to the issuance of lists by roads which have not yet come into the market. On the whole, however, the month has seen a fair volume of business distributed among machine tool houses, representing in large part the smaller types of machinists' and electrical tools. Demand for grinding wheels and abrasives is again on the upgrade after a slight decline. Heavy-duty machinery is moving slowly.

Indications of increased production on the part of the automobile industry and concerns manufacturing auto parts is found in a greater number of inquiries for tools needed in this branch of industry. The Illinois Steel Co. has practically closed out its latest list, used machinery constituting a considerable item in the buying. Additional inquiry is being made by tech schools for small lots. The consensus of opinion among machinery men is to the effect that business during April will show an improvement over March.

NEW YORK

Business in this market has settled down to a steady volume of hand-to-mouth buying. There is nothing spectacular about the present trend, it being the general opinion among dealers that industrial activity is such that conservative buying of equipment is all that can be expected at this time.

Some business from automobile manufacturers was placed last week. The list of tools included 8 deep-hole drills, 2 bench lathes, a bench miller, 2 die sinkers, a profiler, a jig borer and automatic lathe and a centering machine.

Railroads are inactive, only two roads being listed as recent purchasers — the Southern Pacific and the Chicago, Indianapolis & Louisville.

Small hand tools, such as drills and grinders are in demand, as are miscellaneous tool equipment and shop supplies, indicating that machine shops are busy.

CINCINNATI

The majority of machine tool manufacturers in the Cincinnati district report that sales of the past month show a slight decrease, compared to the same month of last year. However, this is not regarded as discouraging, because inquiries are more numerous now than they were then.

Manufacturers and selling agents report that, while there was a slight lull in the first half of the week, business picked up sufficiently in the latter half to bring the sales total to a satisfactory figure.

Orders for single tools and replacements formed the bulk of the past week's business, but several fair-sized orders were received. Concerns in the automotive industry bought more than in the previous week, but the purchases from this source were almost altogether confined to single tools and replacements. Railroads sent several orders for single tools. The greater part of the buying was done by general machinists and industrial users.

An increased number of inquiries came in during the week. These included several lists, but the majority were in regard to single tools. Manufacturers have sufficient orders on hand to maintain production at a good level and it is not regarded as improbable that manufacturing activities will increase in the near future.

CANADA

A quickening of many lines of industry in Canada is proving a boon to manufacturers of machinery and machine tools. Agricultural implement plants, railroad car and locomotive shops and the plants supplying them with parts, as well as the specialty and jobbing machine shops and foundries all report business moving in their direction in greater volume and with more freedom.

The Canadian-Vickers plant at Montreal is well booked in structural work for the new Gatineau development of the International Paper Co., airplane work for the government and boiler and other equipment for the paper mills.

Iron and steel bookings during March showed a substantial increase over February tonnage. Representatives of the steel companies producing rails are jubilant because their mills are busy and there is a prospect of more business being placed soon. In addition to extensive orders for locomotives and passenger cars, recently announced, the Canadian National Railways have placed some large orders with car manufacturers for freight equipment. The Canadian Car and Foundry Co., Montreal, is to manufacture one thousand 60-ton box cars; the National Steel Car Co., Hamilton, Ontario, has an order for 500 automobile cars and fifteen 30-yard air dump cars.

Automobile production recorded an increase of 18 per cent during February, as compared with the output in January. The February output was 18,665 cars as against 15,376 in January.

SOUTHERN DISTRICT

Machinery and tool business in the Southeast continued to show a slow but steady improvement the latter part of March, with indications of further betterment in April. Inquiries have been particularly good and should begin to develop orders in the next two or three weeks.

In the lumber and woodworking field sales are slightly better than they were in February, but not yet showing the volume the trade had anticipated, due principally to rather uncertain conditions existing in the lumber markets. Furniture factories in the Carolina territory are the leading buyers in this field, and some sales are also being made to millwork plants.

Sales of road building machinery are beginning to open up, with the inquiry active and at least normal business in prospect through the spring months. Contractors' equipment is not very active.

Some sizeable orders are now being placed by the textile industry, indications promising a little better than normal business this summer because of the large amount of construction in progress.

Railroads are inquiring on a fair basis for heavier machinery, but not yet buying as actively as the trade had expected. Smaller machine shops continue to buy, principally in the used machinery market.

NEW ENGLAND

Improvement in the machinery building industry is being strongly reflected in the chuck and die making plants in New Britain and Hartford. Conditions now are better than at any time since the war, according to one manufacturer. Demands from the automotive, aircraft and railroad industries are indicated by orders.

The ball bearing industry, reflecting largely the demands of the automobile trade, is active, and a spokesman of the New Departure Manufacturing Co., of Bristol, states that employment is at maximum, with production requiring full time schedules.

Machinery builders report a good volume of prospective business and orders for the first three months are ahead of last year.

INDIANAPOLIS

Demand for machinery and machine tools continues spotty in this territory, though the number of inquiries from various sources leads the trade to believe that better business will be had before another month. Machine tool demand comes principally from the steel plants and is reported fairly good.

Demand for special woodworking machinery is irregular. The furniture factories are buying only what is absolutely needed and with production not the best in the world, this emergency buying is light. The local trade is expecting little increase in furniture factory demand during the next few months. However, demand from lumber manufacturers, hardwood flooring factories and sash and door mills is increasing. There is no disposition toward factory expansions in these lines, but the replacement business is good. Perhaps the best source of demand in this line comes from the body factories, where business is reported good.

The machinery and tool demand from the automobile factories in this state continues good. Marmon, Stutz, Auburn, Studebaker are all operating better than they have for sometime and officials report that the outlook is bright.

DETROIT

A marked improvement has been noted in the Detroit market for machinery and machine tools. While the gain has not been general and is not large yet, there is a definite and apparently well founded development.

Many of the automobile manufacturers are still buying cautiously and endeavoring to keep an even balance. Small machinery and tools are going well and there have been a number of orders for large and highly specialized machines.

The feeling of optimism that has persisted for the past few weeks has been intensified and supported by the persistent rumors of model changes in the case of three of the larger manufacturers of automobiles. Some of the companies have already placed orders and are contemplating larger additions in the future.

Employment figures have remained almost stationary in the past month.

Total Exports Fell Off Last Year

While every continent except Europe made greater purchases of merchandise from the United States in 1926 than in 1925, total exports last year fell off $101,000,000, due largely to the low price of cotton exports. This fact is disclosed in an analysis of America's foreign trade in 1926 made public last week by the foreign commerce department of the Chamber of Commerce of the United States.

"Shipments to Europe," the report shows, "were valued at $2,309,706,000, showing a loss of $294,044,000, or 11.3 per cent, in 1926 over 1925. The decline in the value of the shipments of raw cotton alone to Europe amounted to $241,000,000. The greatest increase in buying of our exports was shown by Asia to which we exported $564,543,000 worth of merchandise in 1926, an increase of $77,951,000 over the previous year's figures. Increases in value of exports of all kinds to the other continents were as follows: South America, $40,902,000; North America, $38,530,000; Oceania, $23,216,000; and Africa, $12,062,000.

"The big five among our export customers—United Kingdom, Canada, Germany, France and Japan—took well over half the total of our nearly 5 billions of dollars of exports; this despite the fact that three of the big five are in Europe, where practically all the chief countries spent less money on American goods last year than the year before. Canadian buying was very heavy, and South America, the Far East, Africa and Oceania increased their purchases.

"The Irish Free State made the greatest advance in rank of all the principal countries,—rising from forty-seventh place to the thirty-first place, more than doubling her 1925 purchases. The only other important increase in Europe was that of Portugal, $2,901,000, or 33.2 per cent.

"Noteworthy gains made by European countries included Germany, $34,210,000, or 21 per cent; Netherlands, $9,355,000, or 10 per cent; Belgium, $8,780,000, or 13 per cent; and Spain, $8,536,000, or 26 per cent. Decreases were registered by Greece, $9,279,000, or 35 per cent; and France, $5,403,000, or 3 per cent.

Praises American Progress in Air Transport

In a recent published interview, Sir Septon Braucker, prominent British nobleman, stated that—"It is interesting to see that the United States and England have done almost everything in opposite directions since the end of the war. The British government has tried to encourage private enterprise by means of subsidies. Subsidies are very unpleasant things and they generally fly back and strike you, like a boomerang.

"Military aviation should be forgotten as much as possible in the administration of air transport. Air transport should grow up naturally and without military ideas or military restrictions; when it grows up and when it is a commercial success, then it will automatically provide a great military reserve.

"America has the proper setting for military and commercial aviation. There are great distances over its own soil with great industrial centers scattered over these great distances. In addition there is better climate offering better visibility to the air navigator."

W. S. Hovey New Head of Fairbanks-Morse Co.

At the annual meeting of the directors of Fairbanks, Morse & Co., W. S. Hovey was elected president and the former president, C. H. Morse, was made chairman of the board. Mr. Hovey is a graduate of Cornell. He joined the Sheffield Car Co., an affiliation of Fairbanks-Morse, in 1902, as assistant superintendent. Later he became superintendent, which position he held until 1913, when he was transferred to the Beloit Works as manager of the engine division. Later he was made general manager of that plant.

W. S. Hovey

In 1919, Mr. Hovey was elected vice-president in charge of all the manufacturing activities, and in 1924, was made general manager of the entire business.

It was also announced that Fairbanks, Morse & Co. had taken over the scale business of the Fairbanks Co. of New York.

"Hornet" Airplane Engine

The Pratt & Whitney Aircraft Co. has developed a second type of air-cooled airplane engine, intended for use in a new type of Navy bombing and torpedo planes. It is called the "Hornet" and develops 550 hp. Official tests under the direction of Capt. Joseph L. Hileman, U. S. N., have just been completed, during which the 550 hp. was developed. The engine weighs 1.3 lb. per horsepower, as compared with 2.5 lb. per horsepower in water cooled engines used in bombing planes in service at the present time.

Tariff Change Will Aid Canadian Auto Trade

Manufacturers of automobile parts and accessories in Canada will benefit to the extent of several million dollars of business owing to a change in the tariff which went into effect in April, whereby the 25 per cent drawback on the import duty of these products, applicable when 40 per cent of the total cost of the motor vehicle represents work done or material supplied from within the Dominion, becomes effective only when at least half the total cost is expended in Canada.

The importance of this change may be realized from the fact that last year over 200,000 motor vehicles, valued at $124,217,074 were turned out by Canadian plants. The year before production amounted to 162,221 units, worth $103,541,751. Comparison with previous years is equally favorable. From now on, the amount of money spent on the manufacture of automobiles in the Dominion will be 50 per cent or more of the value of the aggregate output.

There are a number of companies already in this field which will benefit very largely by this tariff change. The McKinnon Industries, Canadian Acme Screw and Gear, and the Booth-Coulter Brass Co., as well as other concerns have been exceptionally active during the past year on account of increased production of motor vehicles and the imposition of the new drawback ruling will furnish more business.

Manning, Maxwell & Moore Elect Officers

At a meeting of the board of directors of Manning, Maxwell & Moore, Inc., of New York, manufacturers and distributors of machinery and supplies, held on March 16, Charles A. Moore, Jr., was elected president of the company. Mr. Moore has been associated with the company for many years, being a member of the family which has been in the firm since its organization. He has been a vice-president for the past three years. John F. Schurch retired as president and was elected chairman of the board. John D. Nicklis, manager of the supplies and purchases department of the company, was elected a vice-president.

New Rail Shop in Canada

The manufacture of material for maintenance purposes on the Western lines of the Canadian Pacific Railway will in future be done largely at the Western shops in Winnipeg, Manitoba. As a step in this direction tenders are being called for a new building at Weston, an addition to the present blacksmith shop, which will leave the present blacksmith shop free for the manufacture of "frogs." These requirements on Western lines have heretofore been largely filled by Buffalo and Montreal manufacturers. Locomotive parts, especially springs and spring gears, will be made at Weston, and the latest machine tools will be installed for this purpose.

Personals

GEORGE ERWIN, sales manager of the Kearney & Trecker Corporation, of Milwaukee, sailed on April 2 for Europe.

G. F. KONOLD has been elected president of the Warren Tool and Forge Co. of Warren, Ohio.

HUGH PURDY, managing director of Buck & Hickman, Ltd., London, England, has arrived in the United States on a business trip.

FRANK JAROSCH, formerly superintendent of the Gurney Ball Bearing Co., is now in charge of engineering for the S. B. R. Specialty Co., of East Orange, N. J.

D. J. MURPHY has been transferred from the Dallas, Texas, office to the new Baltimore branch office of the Harnischfeger Corporation.

W. J. MCINTOSH has been appointed manager of the Portland, Oregon, office of the Fairbanks Morse Co. He was formerly manager of the hydraulic and electric motor departments in the Seattle office.

HUGH E. P. REARDON has been appointed manager of the supply department of the A. R. Williams Machinery Co., Toronto, Ontario, Canada, to succeed N. I. Green, who has resigned.

CLARENCE S. ARMS, former president and general manager of the Wheeldon Wire Co., at West Brookfield, Mass., has been appointed manager of the continuous wire drawing machinery department of Sleeper & Hartley, Inc., at Worcester, Mass.

R. F. MITTEN, formerly territorial salesman for the Black & Decker Manufacturing Co. in southern Ohio, and working out of the Cleveland branch office, was recently appointed branch manager of the Cleveland territory, filling the vacancy left by C. M. Hall upon his promotion to assistant automotive sales manager.

GEORGE H. WALSH has been appointed to take charge of the new office recently established in Boston by the Young Brothers Co., of Detroit. Mr. Walsh is a sales engineer, widely known in the industrial field, particularly that dealing with foundry supplies and equipment. Mr. Walsh will specialize in consultation on all matters pertaining to the use of industrial ovens and low temperature heat-treating equipment.

FRED ALLISON has resigned as chief electrical and mechanical engineer of the Ford Motor Co., and will engage in consulting engineering work through H. R. Van Deventer, Inc., 342 Madison Ave., New York. Mr. Allison has been connected with Mr. Ford for over twenty years, and his activities have included all the diverse branches of the Ford industries. Mr. Allison's services will be available to a limited number of manufacturers who wish to install production methods originated by him, and he is also in a position to grant licenses under many of his patents to manufacturers in a large number of industries to which these patents may apply.

Obituaries

JESSE MERRICK SMITH, consulting engineer, patent expert and a former president of the American Society of Mechanical Engineers, died at his home in New York on April 1. He was 79 years old. He was a member of the American Institute of Electrical Engineers and the American Institute of Mining and Metallurgical Engineers.

CHARLES F. MITCHELL, president and director of the Steel & Johnson Manufacturing Co., which was recently taken over by the Torrington Co., died at his home in Waterbury, Conn., on March 30, following a long illness. Mr. Mitchell was one of the organizers of the Citizens & Manufacturers National Bank and was chairman of the board.

Citroen Engineers Here

A party of eight of the chief engineers of the Citroen Automobile Co., of France, arrived in the United States on April 2 on the *France*. They have come to make a study of American automobile production methods and to inspect modern shop equipment. While in this country they will make their headquarters at the Citroen offices in the Fisk Bldg., New York.

Business Items

The Kemp Machinery Co., of Baltimore, has removed to larger quarters at 211 President St., Baltimore.

The Spencer Turbine Co. is having plans prepared for an addition to its plant on New Park Ave. in Hartford, Conn.

The Turner Construction Co., announces the removal of its main offices to the Graybar Bldg., 420 Lexington Ave., New York City.

The National Acme Co., of Cleveland, announces the appointment of four new directors: A. B. Breese, F. H. Chapin, A. E. Henn and C. E. Randles.

The Handian-Buck Manufacturing Co., of St. Louis, has been appointed distributor of Triumph motors in that district. These motors are built by the Triumph Electric Corporation, of Cincinnati.

The V. & O. Press Co., of Hudson, N. Y., has been licensed to manufacture the King toggle attachment for single action presses. This patent and the business of the King organization have been purchased by a company which has in turn granted the manufacturing rights to the V. & O. company.

The R. H. Beaumont Co., of Philadelphia, announces that it has taken over the business of the American Manufacturing and Engineering Co., of Kalamazoo, Mich., and will build and sell the equipment of that company. S. O. Nafziger, who was president of the American company, will be associated with the Beaumont organization.

The Philbrick-Booth Foundry Co., of Hartford, Conn., and the Hartford Foundry Co., of Wethersfield, Conn., have merged as Philbrick, Booth & Spencer, Inc. The officers will be as follows: President, Halsey Philbrick; treasurer, Edgar Spencer; secretary, William H. Walther. An addition to the foundry is in process of construction.

Calendar of Local Meetings

Society of Automotive Engineers

Chicago Section. April 12. Subject: "Traffic," by Carroll E. Robb, National Safety Council.

Pennsylvania Section. April 12. Subject: "Traffic Problem," by Harold M. Lewis, Regional Plan of New York.

Indiana Section. April 14. Subject: "Chromium Plating," by C. R. Umphreys, Metal Protection Corporation.

Cleveland Section. April 18. "Air Travel as a Practical Means of Transport," by Col. Paul Henderson, National Air Transport, Inc.

Detroit Section. April 21. General program.

Metropolitan Section. April 21. Subject: "Highways and Vehicles," by Dr. T. R. Agg, Iowa State College.

Dayton Section. April 21. Subject: "Recent Developments in Lighter-than-Air Craft," by Dr. Karl Arnstein, Goodyear Zeppelin Co.

Detroit and A.M.A. Section. April 28. Co-operative dinner. Speaker: C. F. Kettering, General Motors Corporation.

Forthcoming Meetings

American Gear Manufacturers Association. Eleventh annual meeting, Hayes Hotel, Jackson, Mich., May 12 to 14. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Society for Steel Treating. Spring sectional meeting, Milwaukee, Wis., May 19 and 20. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

American Society of Mechanical Engineers. Semi-annual meeting, White Sulphur Springs, W. Va., May 23 to 26. C. E. Davies, secretary in charge of meetings, 29 West 39th St., New York.

Associated Machine Tool Dealers. Annual spring meeting at Granville, Ohio, May 25, 26 and 27. Tyler W. Carlisle, secretary, the Strong, Carlisle & Hammond Co., 1392 West Third St., Cleveland, Ohio.

National Foreign Trade Council. Fourteenth national foreign trade convention, Hotel Statler, Detroit, Mich., May 25, 26 and 27. O. K. Davis, secretary, India House, Hanover Square, New York.

Society of Industrial Engineers. Annual meeting, Hotel Stevens, Chicago, May 25, 26 and 27. George C. Dent, secretary, 608 S. Dearborn St., Chicago, Ill.

Society of Automotive Engineers. Summer meeting, French Lick Springs, Ind., May 25 to 28. C. E. Heywood, manager of meetings department, 29 W. 39th St., New York City.

American Foundrymen's Association. Annual convention, Edgewater Beach, Chicago, June 6 to 10. R. E. Kennedy, secretary, 909 W. California St., Urbana, Ill.

National Supply and Machinery Distributors' Association. Twenty-second annual convention with the **Southern Supply and Machinery Dealers' Association,** and the **American Supply and Machinery Manufacturers' Association,** on board the steamship *Noronic*. Boat leaves Detroit, Mich., June 13 and returns there June 17. George A. Fernley, secretary, 505 Arch St., Phila-

Exposition of Engineering Developments. Under the auspices of the Association of Iron and Steel Electrical Engineers, in the Empire Bldg., Pittsburgh, June 13 to 18. John F. Kelly, general chairman, 705 Empire Bldg., Pittsburgh.

American Society for Testing Materials. Annual meeting at French Lick, Ind., June 20 to 24. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

American Railway Tool Foremen's Association. Fifteenth annual meeting, Hotel Sherman, Chicago, Aug. 31, Sept. 1 and 2. G. G. Macina, secretary, 11,402 Calumet Ave., Chicago.

Machine Tool Exhibit. Seventh annual machine tool exhibition under the auspices of the New Haven Section of the American Society of Mechanical Engineers, the Department of Mechanical Engineering of Sheffield Scientific School, Yale University, and the Chamber of Commerce of New Haven: At the Mason Laboratory, Yale University, Sept. 6 to 9. Harry R. Westcott, chairman of the exhibit committee, 400 Temple St., New Haven, Conn.

American Society for Steel Treating. Ninth annual convention and national steel exposition, Detroit, week of Sept. 19. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland.

Machine Tool Builders' Exposition. First annual machine tool exposition, conducted by the National Machine Tool Builders' Association, at the West Annex of the Public Auditorium, Cleveland, Ohio, Sept. 19 to 24. J. Wallace Carrel, vice-president and general manager, the Lodge & Shipley Machine Tool Co., Cincinnati, chairman of the exposition committee. Roberts Everett, manager of the exposition, 225 West 34th St., New York. Ernest F. DuBrul, general manager of the association, 826 Provident Bank Bldg., Cincinnati, Ohio.

The Weekly Price Guide

Rise and Fall of the Market

FINISHED steel products used throughout the metal trades, show slightly firmer price tendencies, compared with a week ago. Demand has improved at the principal producing centers in tank plates, steel structurals, nails, bars, riveted pipe, steel sheets and light rails. Non-ferrous metals continue dull, despite seasonal acceleration in markets for most of the other materials. The principal hot-rolled steel products continue at $1.90 per 100 lb., f.o.b. Pittsburgh mill, with cutting under to the extent of 10c. per hundred weight, reported in plates.

(All prices as of Apr. 1)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$22.19
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	26.37
BIRMINGHAM	
No. 2 Foundry	18.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	22.76
Virginia No. 2	27.17
Basic	21.76
CHICAGO	
No. 2 Foundry local	21.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	23.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	20.26
Basic	19.76
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.00@4.50
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	4.75@5.25

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.15@2.25	3.50	3.25	3.89
No. 12	2.20@2.30	3.55	3.30	3.94
No. 14	2.25@2.35	3.60	3.35	3.99
No. 16	2.@352.45	3.70	3.45	4.09
Black				
Nos. 18 to 20	2.60@2.70	3.75	3.25	4.15
No. 22	2.75@2.85	3.90	3.40	4.30
No. 24	2.80@2.90	3.95	3.45	4.35
No. 26	2.90@3.00	4.05	3.55	4.45
No. 28	3.05@3.15	4.20	4.70	4.60
Galvanized				
No. 10	2.95@3.05	4.10	3.95	4.40
Nos. 12 to 14	3.05@3.15	4.20	4.05	4.50
No. 16	3.15@3.25	4.30	4.15	4.60
No. 18	3.30@3.40	4.45	4.30	4.75
No. 20	3.45@3.55	4.60	4.45	4.90
No. 22	3.50@3.60	4.65	4.50	4.95
No. 24	3.65@3.75	4.80	4.65	5.10
No. 26	3.85@3.95	5.05	4.90	5.35
No. 28	4.10@4.20	5.30	5.15	5.60

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches — ¼	⅜	½	⅝	1	1½	1½
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	4.50	6.00@7.50	4.65
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (2.75 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, 3/32, 8.35c.; ⅛, 7.85c.; 5/32 to ½ 7.35c. per lb. *Flat, 1/16@½-in. thick.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic, up to carlots, New York	14.37½		
Tin, pigs, 5-ton lots, New York	70.25		
Lead, pigs, up to carlots, E. St. Louis	7.12½	New York	8.00
Zinc, slabs, up to carlots, E. St. Louis	6.55	New York	7.50

	New York	Cleveland	Chicago
Antimony, slabs, ton spot	15.50	18.50	16.25
Copper sheets, base	22.00	22.00	22.00
Copper wire, base	18.87½	18.87½	15.37½
Copper bars, base	21.62½	21.62½	21.62½
Copper tubing, base	24.00	24.00	24.00
Brass sheets, high, base	18.37½	18.37½	18.37½
Brass tubing, high, base	23.25	23.25	22.75
Brass rods, high, base	16.12½	16.12½	16.12½
Brass wire, high, base	18.87½	18.87½	18.87½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	26.00	26@27	26.02
Zinc sheets (casks)	13.00	12.30	11.36
Solder (½ and ½), (case lots)	42.00	43.75	38½@42½

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	87.00
Commercial genuine, intermediate grade	61.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	13.50

Nickel, f.o.b. refinery, cents per lb.:

Ingots	35.00	Electrolytic	39.00
Shot			36.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	35.00
Blocks	32.00	Cold drawn rods (base)	43.00
Cold rolled sheets (base)	50.00	Hot rolled sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.50 @11.75	10.75	10.75@11.25
Copper, heavy, and wire	10.75 @11.37½	11.00	9.75@10.25
Copper, light, and bottoms	9.50 @10.00	9.50	8.75@9.25
Heavy lead	6.50 @6.75	6.25	6.00@6.50
Tea lead	5.00 @5.25	4.25	4.75@5.25
Brass, heavy, yellow	7.25 @7.50	7.50	6.75@7.25
Brass, heavy, red	9.25 @9.75	9.50	9.00@9.50
Brass, light	5.50 @6.00	6.00	6.00@6.50
No. 1 yellow rod turnings	7.50 @8.00	7.50	7.00@7.50
Zinc	4.25 @4.50	4.00	3.25@3.75

TIN PLATES—Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20	9.70	9.90	9.50
	Coke Plates—Primes—Per box			
100-lb.,	14x20	6.45	6.10	7.00
	Terne Plates—Small lots, 8-lb. Coating—Per box			
IC,	14x20	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.10@0.13½	$0.16	$0.15@0.20
Cotton waste, colored, per lb.	.09@.13	.12	.12@.17
Wiping cloths, washed white, per lb	.15½@.17½	36.00 per M	.15
Sal soda, per 175 lb. keg	2.80	2.75	2.75
Roll sulphur, per lb.	.04	.03½	.04
Linseed oil, raw, per 7½-lb. gal., 5 bbl. lots	.80½	.98	.83
Lard cutting oil, 25% lard, in 5 gal. cans, per gal.	.55	.50	.50
Machine oil, medium-bodied (55 gal. metal bbl.), per gal.	.33	.35	29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
Firtt grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.04
Brass rods	per lb.	.1612½	.1562½	.1687½
Solder (½ and ½)	per lb.	.42	.4212½	4012½
Cotton waste, white	per lb.	.10@13½	.13@.17½	.15@.17½
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery disks, cloth, No. 1, 6 in. dia.	per 100	3.10	3.10	3.55
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.33	.33	.35
Belting, leather, medium	off list	40–5%	40–5%	40–5%
Machine bolts, up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.13*	$4.95	$5.13
Emery paper	10.71*	9.15	10.71
Emery cloth	27.84*	27.85	27.84
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.29	1.27	1.32
Cloth	3.10	3.05	3.05
Fire clay, per 100 lb. bag		.75	.75

Coke, prompt furnace, per net ton	Connellsville,		3.25@3.50
Coke, prompt foundry, per net ton	Connellsville,		4.25@4.75
White lead, dry or in oil,	100 lb. kegs	New York,	15.25
Red lead, dry,	100 lb. kegs	New York,	15.25
Red lead, in oil,	100 lb. kegs	New York,	16.75

*4½ reams and under.

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{A}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ½x½-in., 2c. each. Discount 70% for $\frac{A}{16}$-in and smaller and 65% for ¼-in. and larger.
Case hardened ½x½-in., 6c. each, less 50%.

Rivets, button heads, ½-in., ¾-in., 1-in. diam. x2$\frac{A}{16}$-in. to 4½-in $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{A}{16}$x1-in. and smaller, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1½ to 2-in. long, all diameters, 25c.; ½-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb. 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ¾-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Equipment Wanted

Calif., Long Beach — Ford Motor Co., Highland Park, Mich.—cranes, conveyors, etc., for proposed 1 story assembly plant, here.

Colo., Pueblo — Midwest Steel & Iron Works, Denver—milling machines, planers, presses, column machines, etc. for proposed first unit to plant here.

Ind., Anderson—General Motors Corp., 3044 West Grand Blvd., Detroit, Mich.—machinery and equipment for the manufacture of automobile distributors for proposed 1 story, 240 x 400 ft. factory here.

Mass., Brockton—City Hall Sq. Garage Co., East Elm St.—miscellaneous tools and equipment for proposed 2 story repair and service garage. Estimated cost $100,000.

Mich., Port Huron—Mueller Brass Co., O. E. Mueller, Purch. Agt.—equipment for brass finishing shop and nickel plating equipment.

N. Y., Brooklyn—B. F. Gilmour Co., 147 41st St.—4 in. or 6 in. Landis or Saunders pipe threading and cutting machine, also Landis pipe chaser grinder.

N. Y., Oxford—S. W. Adams—machinery for the manufacture of twisted wire and wooden slat snow fence.

O., Columbus — Columbus Purchasing Board, City Hall, H. C. Cain, Secy.—quick change gear lathe, medium size.

O., Kent — Lanson, Sessions Co. — machinery for the manufacture of nuts, bolts and rivets for proposed 1 story factory to cost $40,000.

O., Lakewood—Artisan Metal Works Co., 13019 Athens Ave., D. L. Britten, Mgr.—machinery and equipment for new sheet metal works.

Pa., Pittsburgh—Pittsburgh Commercial Heat Treating Co., 919 Fulton Bldg., A. M. Cox, Purch. Agt.—overhead electric crane for proposed new heat treating plant.

Tenn., Humbolt—J. R. McFarland, Inc.—36 in. x 14 ft. lathe with single pulley drive.

Wis., Milwaukee — A. H. Friese, 610 Michigan St.—electric arc welder.

Opportunities for Future Business

Calif., Long Beach — Ford Motor Co., Highland Park, Mich., is having plans prepared for the construction of a 1 story assembly plant here. Estimated cost $500,000. A. Kahn, 1000 Marquette Bldg., Detroit, Mich., Archt. Noted Aug. 26.

Calif., San Francisco—Fishbeck Soap Co., DeHaro and Mariposa Sts., awarded contract for the construction of a 2 story, 200 x 247 ft. can factory at 17th and Rhode Island Sts. Estimated cost $200,000. Western Can Co., 180 Townsend St., lessee.

Calif., San Jose—C. W. McKenzie, Bank of San Jose Bldg., Archt., is receiving bids for the construction of a 1 story machine shop on Vine St. for Hellwig Iron Works, 67 Almaden Ave. Estimated cost $20,000.

Calif., Van Nuys—Van Nuys Valley Planing Mill, plans to rebuild planing mill recently destroyed by fire.

Colo., Pueblo — Midwest Steel & Iron Works, Denver, awarded contract for the construction of first unit to plant, here. Estimated cost $25,000. Additional units will be built later.

Conn., Hartford—Spencer Turbine Co., I. Spencer, Pres., 484 New Park Ave., awarded contract for the construction of a 1 story, 75 x 210 ft. plant. Estimated cost to exceed $40,000. Noted Mar. 24.

Fla., Jay—Downs Motor Co., 810 Hogan St., is having plans prepared for the construction of a 2 story, 75 x 260 ft. garage at 446 Riverside St. Estimated cost $175,000. C. B. Schoeppl, 601 Consolidated Bldg., Archt. and Engr.

Ill., Chicago—Beardsley & Piper Co., 2541 North Keeler Ave., manufacturers of foundry equipment, awarded contract for the construction of a 1 story, 34 x 60 ft. factory at 2627-2657 North Keeler St. Estimated cost $30,000.

Ill., Chicago—Mudge & Co., 4425 West 16th St., manufacturers of railroad specialties, awarded contract for the construction of addition to factory at 4441-4447 West 16th St. Estimated cost $26,000.

Ind., Elkhart—Adams & Westlake Co., 319 West Ontario St., Chicago, Ill., brass founders, finishers, etc., is having plans prepared for the construction of a plant here. Estimated cost $400,000. Mundie & Jenson, 39 South La Salle St., Archts.

Ia., Rockwell City—City, W. E. McClure, Maintenance Supt., will receive bids until Apr. 12 for the construction of a 26 x 96 ft. machine shop.

Kan., Chanute—Bd. of Education, will receive bids until Apr. 11 for the construction of a 100 x 150 ft. and 56 x 87 ft. addition to senior and junior high schools including shops, etc. Estimated cost $200,000. T. W. Williamson & Co., Central National Bank Bldg., Topeka, Archts. Noted Feb. 3.

Ky., Louisville—F. B. Lincoln, of Lincoln Engineering Corp., et al., Riverside, Conn., manufacturers of heat resisting material, plans the construction of a plant at 16th and Avery Sts., here. Estimated cost $2,000,000. Architect and engineer not selected.

La., Bossier — The Products Tank Line Co., H. Mendel, Gen. Foreman, Baton Rouge, will build a 1 story repair shop here. Estimated cost $50,000. Private plans.

Me., Portland—Dartmouth Realty Corp., has work under way on the construction of three 2 story, 80 x 180 ft. garage buildings on Forest Ave. Estimated cost $75,000 each. F. A. Rumery, Archt. and Engr.

Mass., Allston (Boston P. O.)—C. Blankmeyer, 91 Brighton Ave., Boston, is receiving bids for the construction of a 3 story, 50 x 90 ft. repair and service garage, here. Estimated cost $70,000. S. S. Levy, 35 Court St., Boston, Archt.

Mass., Beverly Farms—Trowt & Murray, 715 Hale St., is receiving bids for the construction of a 1 story repair and service garage on Hale St. Estimated cost $40,000. M. F. Silver, Naugus Ave., Marblehead, Archt.

Mass., Brookline (Boston P. O.) — A. Goodman, c/o H. J. Bryant & Son, 334 Washington St., is having plans prepared for the construction of a 1 story machine shop at Harvard St. and Alton Pl. Estimated cost $40,000.

Mass., Newton (Boston P. O.)—P. A. Murray & Co., 210 Washington St., awarded contract for the construction of a 2 story repair and service garage. Estimated cost $40,000. Noted Jan. 13.

Mass., Springfield—Memo Garage Corp., F. W. Lumis, 28 Bedford Rd., is receiving bids for the construction of a 5 story, 130 x 210 ft. garage on Vernon St. H. C. Hearne, 1387 Main St., Archt.

Mass., Springfield — Owner, c/o F. C. Lumis, 28 Bedford Rd., is having plans prepared for the construction of a 5 story, 130 x 200 ft. garage on Vernon St. Estimated cost to exceed $150,000. H. C. Hearne, 1387 Main St., Archt.

Mass., Swampscott (Lynn P. O.)— M. McDonough, 622 Humphrey St., will build a 1 story repair and service garage. Estimated cost $75,000. Private plans.

Mass., Worcester — Smith & Fyfe, 130 Southbridge St., is having plans prepared for the construction of a 1 story repair and service garage on Grove St. Estimated cost $40,000. J. Rustigian, 16 Norwich St., Archt.

Mo., St. Louis—Southwestern Bell Telephone Co., 11th and Pine Sts., will soon receive bids on revised plans for the construction of a 2 story, 90 x 100 ft. garage at Tiffany St. and Chouteau Ave. I. R. Timlin, 1917 Southwestern Bell Bldg., Archt.

N. H., Nashua — City, P. D. Sargent, Mayor, is receiving bids for the construction of a 1 story, 60 x 200 and 55 x 60 ft. machine shop and garage at East Hollis and Dearborn Sts. S. Belanger & Son, 308 Main St., Archts. Noted Mar. 24.

N. J., Elizabeth—Lidgerwood Mfg. Co., 96 Liberty St., New York, N. Y., manufacturers of hoisting engines, will soon award contract for the construction of a 1 story, 110 x 600 ft. factory at Middlesex and Essex Sts., here. Estimated cost $350,000. R. T. Cory, 30 Church St., New York, Archt.

N. J., Trenton—Norman P. Druck Motor Co., 636 East State St., awarded contract for the construction of a 2 story repair shop and service station. Estimated cost $75,000.

O., Chillicothe—Dept. Highways & Public Works, G. F. Schlesinger, Dir., Ohio-Hartman Bldg., Columbus, is having plans prepared for the construction of a 1 story, 80 x 300 ft. repair and service garage, here. Estimated cost $75,000. H. B. Briggs, Ohio-Hartman Bldg., Columbus, Archt.

O., Cleveland—F. Fronek, 5303 Doloff Rd., is having plans prepared for the construction of a 2 story, 50 x 117 ft. addition to garage and repair shop. Estimated cost $40,000. T. Cerny, 4025 East 52nd St., Archt.

Pa., Philadelphia—Jacob Bloom Co., 1049 Frankford St., manufacturers of cedar chests, will soon award contract for the construction of a 4 story, 40 x 80 ft. addition to factory at Frankford and Wildey Sts. William Lowenthal, 1208 Chestnut St., Archt.

Pa., Philadelphia—B. Linker, 204 South 7th St., manufacturers of woodworking equipment, will build a 4 story, 47 x 86 ft. plant at 213 South 9th St. Estimated cost $40,000. Private plans.

R. I., Pawtucket—Pawtucket Times, C. O. Black, Pres., is receiving bids for a 1 and 2 story garage and repair shop on Montgomery St. Estimated cost $50,000. R. C. N. Monahan & R. C. Meikle, 255 Main St., Archts. Noted Mar. 3.

Tenn., Chattanooga—Century Co., W. E. Brook, Pres., is having plans prepared for the construction of a 125 x 375 ft. garage on Broad St. Estimated cost $100,000. C. E. Bearden, First National Bank Bldg., Archt.

Tex., Dallas—Neiman-Marcus Co., Main and Ervay Sts., awarded contract for the construction of a 4 story shop on Ervay St. Estimated cost $300,000.

Wis., Mazomanie—The City Garage Co., is having plans prepared for the construction of a 2 story, 60 x 100 ft. service station. Estimated cost $40,000. A. E. Small, Madison, Archt. Noted Mar. 10.

Ont., Guelph — Guelph Stove Co., subsidiary of T. Eaton Co., Ltd., Yonge and Queens Sts., awarded contract for the construction of addition to stove factory. Estimated cost $50,000.

Ont., Leaside—Canadian National Railways, Montreal, Que., plans the construction of a machine shop, coach and repair shops, etc., here. Estimated cost $400,000. C. S. Gzowski, Ch. Engr.

Ont., Peterborough—Western Clock Co., Hunter St., is having plans prepared for the construction of a 3 story addition to factory. Estimated cost $150,000. B. H. Prack, 42 James St. N., Hamilton, Archt.